AIR CONDITIONING HEATING AND VENTILATING

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT
for
AIR CONDITIONING
HEATING • VENTILATING
PIPING • PLUMBING

JULY 1961

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Guinea pig getting clean bedding at air conditioned Ft. Detrick animal farm. See two articles on air conditioning modern research laboratories starting on page 65.

Valves Work Harder in a Tire Plant . . .

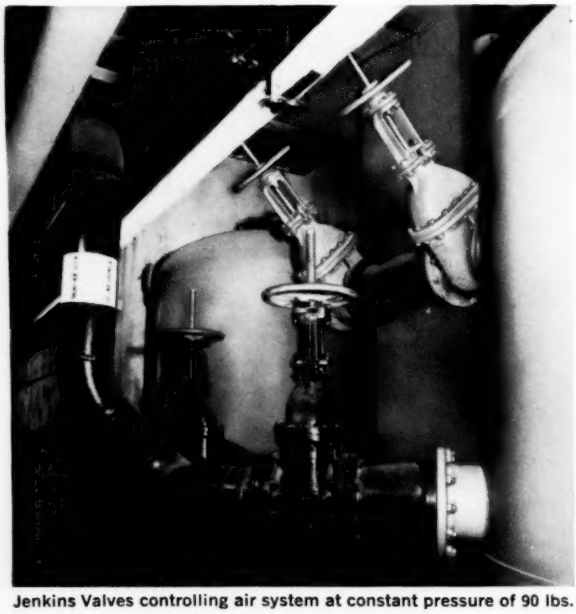
Over 600,000 sq. ft. plant with capacity of two million tires a year. Designed by engineering staff of Gates Rubber Co.
General Contractor: RUST ENGINEERING CO., Birmingham, Ala.

GATES specified the valves that stand hard work, longer . . . JENKINS VALVES

Because high pressure steam, compressed air and water play a big part in making auto and truck tires, valves work unusually hard in this new Gates Rubber plant near Nashville, Tenn.

To be sure of valves that would stand such punishing service, Gates Rubber called for Jenkins Valves. And, with 2500 of them controlling processing and service lines, Gates can look forward to substantial savings in valve maintenance and replacement costs.

Your job for valves may not be so tough, but the extra-quality of Jenkins Valves is well worth specifying . . . especially since you pay no more for it. It's true . . . Jenkins Valves not only *cost less* in the long run.— they *cost no more* to buy. Jenkins Bros., 100 Park Ave., New York 17.



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Some Straight Talk On Steam Trap Capacity

...or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counterclaims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

Area of orifice is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

Density of condensate depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

Pressure differential across the trap is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

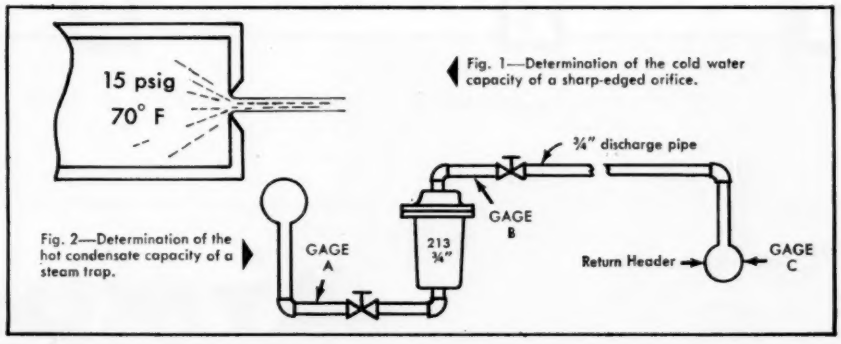
2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:



Density of condensate. As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

Pressure differential across the trap. With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hookups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

Armstrong Machine Works
8461 Maple Street
Three Rivers, Michigan

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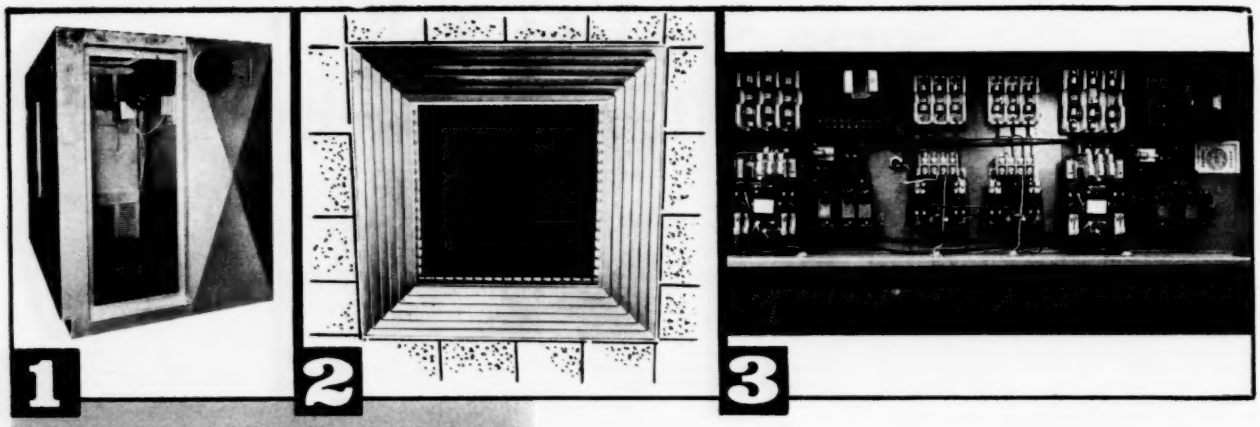
"See our Catalog in Sweets Plant Engineering File"



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1. **MECHANICAL CHIMNEY** assures positive elimination of flue gases and does away with the need for unsightly stacks.

2. **SUPPLY & RETURN AIR DISTRIBUTION CHAMBER** with controlled air pattern is easily adaptable for duct connections in all directions.

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4. **ALL COMPONENTS** are totally protected against the elements in a completely weathertight and fully insulated aluminized steel enclosure.

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For the Engineer
Engaged in DESIGN
APPLICATION
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HEATING • VENTILATING
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COVER PHOTO: This month's Reference Section consists of **two articles on air conditioning of laboratories;** the first deals with the electronic research and development center; the second, with biological laboratories where the environment for small animals must be controlled. In either case, the occupant of the space, **scientist or guinea pig,** must be studied first. The articles start on page 65.

HIGH SPOTS in this issue

OFF-PEAK STORAGE: **Storing of heat developed from electric energy** during night and other off-peak hours and drawing on this heat during periods of heavy heat requirements is a subject of interest to heating engineers and electric utilities alike. This is the theme of our lead-off article, authored by E. R. Ambrose and beginning on page 51. He takes a look at the development, present methods, and future progress of this stimulating subject.

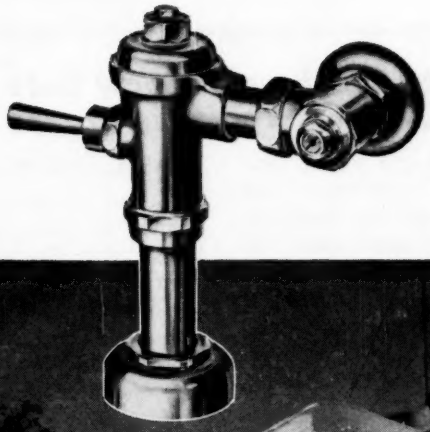
AIR CLEANING: Bowling alleys, taverns, and textile mills have one thing in common, according to W. A. Smith in his article which starts on page 57—they are all **potential applications for electronic air cleaners,** and especially electronic air cleaners teamed with activated charcoal filters to form "air-recovery systems." These dirt-catching, odor-killing, cost-saving systems are discussed, along with electronic air cleaners in general, including helpful design, installation and maintenance techniques.

VENTILATION SHORT CIRCUIT: Some surprising things about the behavior of **gases vented to the roof** (and recirculated) were reported last month at the Air Pollution Control Association meeting. For a concise summary of the paper, see page 81.

ESTIMATING: We are very encouraged by the interest being expressed in the series on estimating costs authored by Robert J. Smith. Last month's installment began publication of tables, called Job Time Reference Data, which contained specific estimating data in terms of minutes and man-hours of labor to perform various tasks related to the installation of welded and screwed pipe and fittings. These tables are continued this month, page 61, and they cover **installation time for cast iron pipe and fittings.**

APPLICATIONS AND INSTALLATIONS: This department starts on page 94 this month, and leads off with the story of how a paper conditioning process, used by the U.S. Army Map Service at an installation in Tokyo, Japan, was found to be **exposing workers to formaldehyde concentrations.** The situation was corrected and the story is told by an industrial hygiene engineer who was there.

And in Puerto Rico — A FUTURE OF FAULTLESS SERVICE



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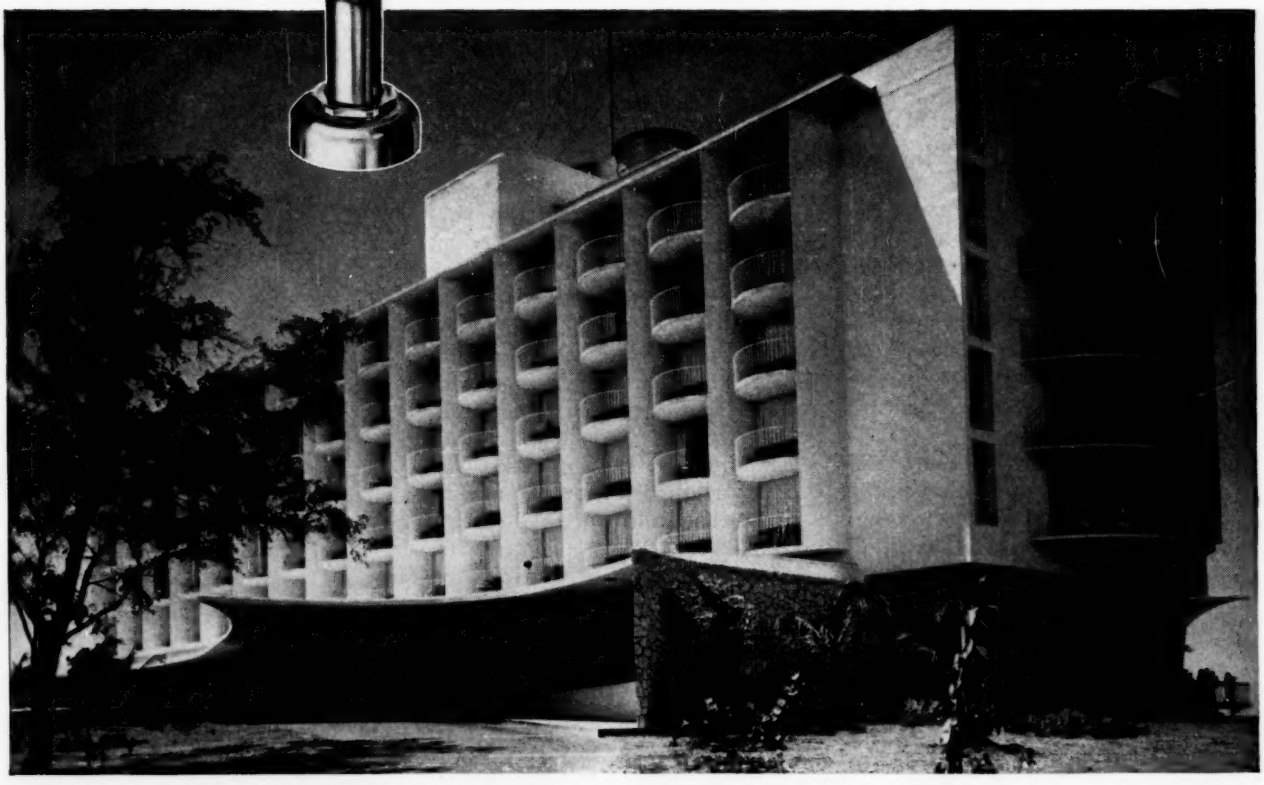

On a green and sunny hilltop overlooking the lovely southern shore of Puerto Rico stands the 170 room El Ponce Intercontinental, latest addition to the Intercontinental Hotels group. Constructed at a cost of $3,750,000, this DELANY installation provides a dramatic view of both a charming 18th Century city and the Caribbean Sea. With swimming, deep sea fishing, golfing, and skin diving all immediately available, carefree relaxation comes easily at the El Ponce. The specification of DELANY diaphragm type Flush Valves means elimination of cares for the maintenance staff also. Smooth action, consistent performance, the ultimate in ease of repair; all these are hallmarks of DELANY Valves. You can depend on DELANY . . . for a future of faultless service. COYNE & DELANY CO., 828 Kent Avenue, Brooklyn 5, New York.

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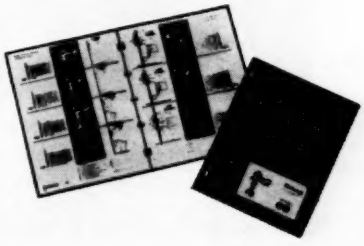
It's the most complete handbook on flush valve selection, specification and installation ever put into print. A request on your company letterhead will put your copy in the mail.



NEWS OF THE MONTH

ANTI-FREEZE CAN HURT SOME REFRIGERATION SYSTEMS

Research by engineers from du Pont and refrigeration motor manufacturers point to improvement in new hermetic motors in refrigeration systems produced this year. Findings also add emphasis to continued warnings against adding anti-freezes to refrigeration systems.

Many hermetic motors this year contain Mylar polyester film insulation. Being a "non-water-forming" material even at high temperatures, the film provides longer, trouble-free life for the motor and the entire system. In the event of motor burn-out, the film does not char or produce carbonaceous materials which foul refrigerant lines.

Several hermetic compressor manufacturers now are pointing out to refrigeration service engineers that, to reap the benefits of the new development, they should avoid adding methanol to refrigerants as an anti-freeze medium.

Methanol, even in small quantities, not only corrodes aluminum, but causes gradual embrittlement of the Mylar polyester film insulation as well. Moreover, it does not remove water or other contaminants from the system.

ARI Activity Quickens as Show Date Nears; Local Law and Warm Air Groups Organized

A new section and a new committee of Air-Conditioning and Refrigeration Institute, Washington, D. C., were announced. At the same time, it was learned that, as of April, more than half of the space for ARI's national trade show, scheduled for February, 1962, in Los Angeles, had already been assigned.

The new ARI committee, temporarily named the Committee on Stage and Municipal Laws and Regulations, will keep advised of all impending codes involving public health and safety and affecting design, manpower, sales, installation, and service of air conditioning and refrigeration system; review related codes (electrical, plumbing and heating codes, for example) to determine if modifications are called for; and call attention to activity disguised as safety measures, in restraint of free trade.

Henry G. Strong of the ARI staff was named chairman of the new committee. He was formerly executive secretary of the Air-Conditioning and Refrigeration Industry Safety Committee (ARISC) whose activities, in part, the new committee on codes is assuming.

Non-Residential Warm Air

A new Product-Section, to be known as the Non-Residential Warm Air Heater Section, has been organized within ARI with six member companies joining at the organizational meeting. A number of other companies, not now members of ARI, are considering joining. A number of present ARI member companies manufacturing products within the scope of the new Section are expected to join.

N. H. Stern, marketing manager—industrial, Lennox Industries, Inc., was elected chairman of the new Section, whose recommended scope will cover "Warm air heaters, of 200,000 Btuh output and above, which are factory assembled and fire-tested, suitable for use with oil, gas, or a combination of fuels, consisting of a burner unit, heat exchangers, blower section, casing, and controls. These heaters are suitable for use with ducts, discharge nozzles, grilles or louvers, and filters."

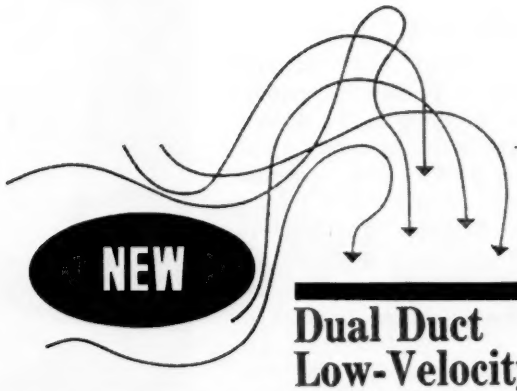
Members of the Section, whose representatives attended the organizational meeting, include American Foundry & Furnace

(Continued on page 8)

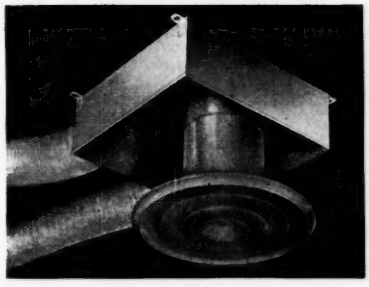
Members of ARI's newest committee, temporarily titled "Committee on State and Municipal Laws and Regulations," pictured at its organizational meeting in Washington, D. C. Standing, left to right, are: J. B. Chamberlain and M. S. Lebair (York); ARI Managing Director Geo. S. Jones; Coit B. Lytton (Lennox); A. O. Anderson (Trane); and seated, ARI Chief Engineer Fred Reed; Chairman H. G. Strong (ARI); W. H. Aubrey (Frick); R. C. Hartman (Airtemp); R. L. Williams (du Pont); and W. H. Campbell (Westinghouse).

Carnes is first to offer engineers and contractors a completely packaged low-velocity control unit specifically designed to meet the requirements of dual duct low-velocity systems. Carnes Low-Velocity ATC Units . . . where limited space does not demand the smaller duct size of high-velocity systems . . . offer all the advantages of individual room control inherent in dual duct air distribution systems. 2 ATC Ceiling Models — end discharge and bottom discharge in 5 sizes. 2 ATC Window/Perimeter Models — front and top discharge in 2 sizes.

LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION



Dual Duct Low-Velocity ATC Units



NOW DUAL DUCT COMFORT AT LOW-VELOCITY COST

Carnes Low-Velocity Acoustic Terminal Control Units — ATC — provide "pinpoint" temperature control for specific zones through the flexibility of dual duct air distribution without the need for sealed ducts, high pressure fans and high fan horsepower. Carnes Low-Velocity ATC Units proportion the hot and cold air in response to individual room thermostats . . . blend the hot and cold air for discharge to individual space areas . . . attenuate self-generated noise plus duct-carried noise . . . provide manual volume adjustment.

For complete information, write for Carnes Low-Velocity ATC Catalog 1361.

Carnes also manufactures: High-Velocity ATC Units • Modular, Round, Rectangular, Square, Convertible and Baseboard Diffusers • Registers • Grilles • Roof and Wall Ventilators.

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ARI SHOW NEARS

(Continued from page 6)

Company, Lennox Industries Inc., Mammoth Industries, Inc., National Heater Company, Inc., Tjernlund Manufacturing Co., and York-Shipley, Inc.

An ARI Standard will be developed for the types of equipment covered in the Section's scope definition, and a certification program will probably follow.

Plans Laid for AC & R Week

Total space of ARI's national trade show in present, permanent buildings is 67,000 sq ft. Almost ten months before the show opens (February 12-15), firm contracts and space assignments totaled more than half this figure.

Meanwhile, plans for the "Air Conditioning and Refrigeration Week" activity at Los Angeles coincident with the ARI show, are moving forward. With the show as a nucleus, several of the participating industry associations will hold their national conventions in Los Angeles, and the Western Air Conditioning Industries Association will stage a program of technical sessions with outstanding speakers on subjects of interest to the entire industry.

Organizations which will hold meetings include: Air-Conditioning and Refrigeration Wholesalers, Refrigeration and Air Conditioning Contractors Association, and Refrigeration Service Engineers Society, in addition to the Western group, which will act as host for the entire event.

At the same time, H. T. "Hy" Jarvis, president of Recold Corporation, Los Angeles, general chairman of the ARI Show Committee, announces that special promotional activities now being planned to assure a representative attendance of architects, engineers, contractors, builders, service engineers, wholesalers, and other industry groups, as well as their customers, are being handled both through Los Angeles and the Washington headquarters of ARI.

ICE MAKER: A working model of a thermoelectric ice maker is demonstrated by A. B. Newton, vice-president and manager of research and development for York Division of Borg-Warner Corporation. Speaking before the Susquehanna Section of ASME on developments in automotive air conditioning, he predicted that the thermoelectric principle may be used, some day, in air conditioning autos, homes, factories, and space vehicles.

AIR CONDITIONED WORKERS FOUND KEY TO NEW PROFITS

Studies in 14 industries show that increases in earnings due to air conditioning for worker comfort have regained from 20-100% of the investment in air conditioning installations during the first year. Russell Gray, president of Carrier Air Conditioning Company which conducted the survey, said the 19 factories studied make products ranging from auto seat covers and filing systems to electronic components for the Nike Zeus missile.

American Kleer-Vu Plastics, which makes transparent page protectors in a plant at Brownsville, Tenn., earned a 32% return last year on its investment in air conditioning, Mr. Gray said. "Summer output jumped so substantially that annual production was up 6.5%," he added. "Absenteeism dropped 17% and labor turnover went down 23% from previous levels."

(Continued on page 10)

Carnes engineers lick high-velocity split service problems with new simplified all-pneumatic constant volume control. Only Carnes new Acoustic Terminal Control Units offer all these features: positive temperature mixing with integral blender; full acoustic baffling; inch-thick acoustic lining; metal protection on leading edges of lining; flow path not obstructed by perforated material; accurate pressure-drop sensing tips; non-stick, leak-free resilient valve seats. 3 ATC ceiling models — end discharge . . . bottom discharge . . . multi discharge. 2 ATC window/perimeter models — front discharge . . . top discharge. All models are available in single or dual duct with full control selection.

LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION

High-Velocity All-Air ATC Units

Carnes Acoustic Terminal Control Units feature new simplified all-pneumatic constant volume control with direct valve to motor connections, eliminating troublesome mechanical devices such as curtains, flappers, bladders, linkages. Carnes new ATC Units assure trouble-free lifetime operation. Investigate now. Write for ATC Cataleg No. 1160.

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FACTORY COOLING PAYS

(Continued from page 8)

Mr. Gray said the Transicoil Division of Daystrom, Inc., in Worcester, Pa., which makes mechanisms to keep missiles on target, earned a 41% return on its investment after an existing system was re-engineered. Increased summer production raised the annual output 2.7% and the number of rejects was reduced 5%. Labor turnover dropped 25% and absenteeism was virtually eliminated.

Densal Manufacturing Corp., West Springfield, Mass., increased its earnings enough to pay off the cost of the air conditioning system in less than one year. Other firms reporting good returns on their investment in air conditioning, according to Mr. Gray were Simpson Electric Co., Chicago, with an 80% return, Acme Visible Records, Inc., of Crozet, Va., with 35% and Nardis Sportswear, of Dallas, with 31%.

The survey showed that the average annual owning and operating cost of air conditioning was less than 2% of annual wages and the resulting increased returns almost always exceeded the cost of owning and operating the air conditioning system.

From the nineteen plants studied, average costs for a "high quality" factory air conditioning system were computed. The plants, Mr. Gray said, averaged 30,000 sq ft in floor area occupied by 150 workers on the first shift and 50 on the second. The initial investment per worker averaged $400 or $79,000 for the space described. The average annual owning and operating cost for air conditioning was $76 per worker. The cooling capacity required was 140 tons.

Plant owners and managers are generally skeptical about air conditioning their production facilities, Mr. Gray declared, because heat loads are greater in factories than most other types of buildings. However, he noted that Carrier has prepared an investment analysis form which the owner can use to determine the amount of annual return he can expect on his investment in air conditioning. Furthermore, it is not always necessary to air condition an entire factory. "Generally," Mr. Gray said, "only areas where there is an average of one worker per every 150 square feet will prove profitable for installation of air conditioning." There are approximately 6 billion square feet of factory floor area in the nation, of which only 6% is air conditioned. A sizeable portion of this area may not be profitable to air condition, he said, but the rest represents a potential area for increasing production.

THREE STUDENTS FROM PURDUE University, Lafayette, Ind., won awards from the ASHRAE Central Indiana chapter at the Annual meeting of the Society at Indianapolis. Carl E. Grinstead, Kokomo, received the W. T. Miller award and will have his name engraved on the permanent plaque. Shown left to right are: George R. Rawlinson, Crossville, Ill.; Grinstead; Prof. Emeritus William T. Miller; and John P. Kamman, Brownstown. All three students received books in the field of heating, refrigeration, and air conditioning.

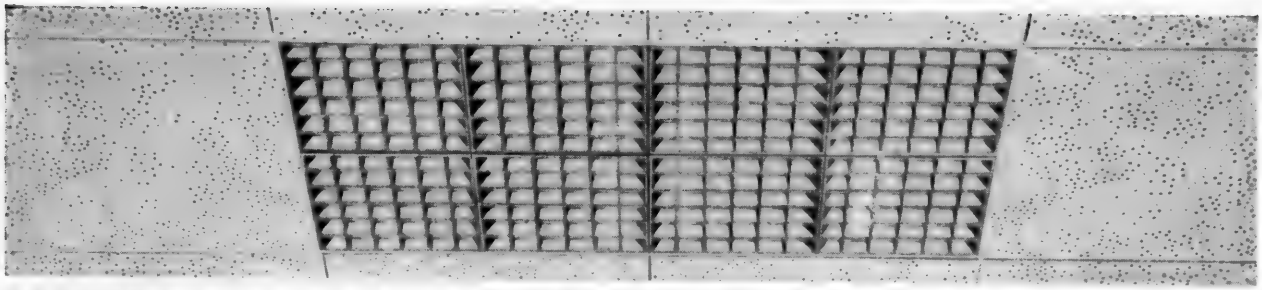
IMPORTANT CHANGES PENDING IN FUEL OIL STANDARDS

An important change affecting fuel oil standards and specifications of No. 2 oil is under serious consideration by Technical Committee E, Section D-2, American Society for Testing Materials, according to Richard C. Wright, Committee chairman and vice-president — engineering, Iron Fireman Manufacturing Company, Cleveland, Ohio.

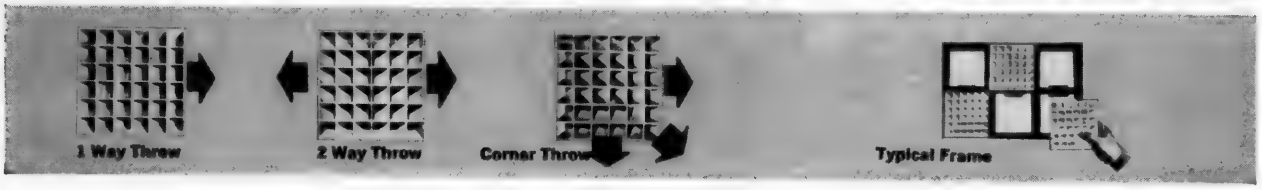
The change would alter minimum API gravity from 26 to 30, except for certain Pacific Coast states, where the minimum would be 28.

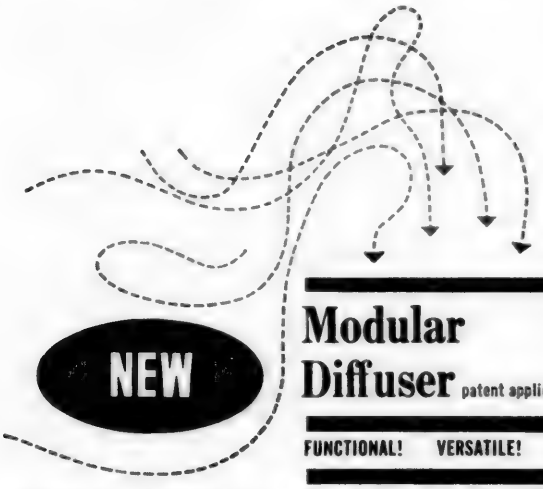
For many years, much research has been conducted in burning characteristics of light distillate fuels in an effort to establish a good index of burning qualities. Factors, such as viscosity, carbon-hydrogen ratio, diesel index and cetane index are indicative to a certain extent, but API gravity appears to be the single index of

(Continued on page 12)



LEADERS GO TO CARNES FOR THE NEWEST IN AIR DISTRIBUTION





NEW

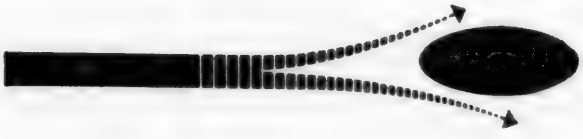
Modular Diffuser patent applied for

FUNCTIONAL! VERSATILE! UNOBTRUSIVE!

Carnes attractive white Model "M" Modular Diffuser enhances the aesthetic quality of any ceiling. The 6-inch square modules fit virtually flush with ceiling . . . have a minimum of see-through . . . inhibit smudging . . . easily slip in or out for changing air direction or cleaning. An infinite number of patterns and sizes are yours by combining multiples of three modules: 1 way throw, 2 way throw, corner throw. Continuous strip patterns . . . cross patterns . . . alternating patterns may be developed to solve any design or air distribution problem. Module units . . . above windows . . . between fluorescent fixtures . . . around columns or walls . . . butted to light fixtures . . . carry out architectural lines and blend with all ceiling materials. They are equally effective when used as an air return. Modules are made from General Electric's revolutionary new LEXAN, a self-extinguishing, high-impact material that withstands temperatures to 225° without distortion. Frames are available in a wide variety of sizes and types . . . easily joined to make any continuous length or width desired. For complete details, write for Modular Diffuser Catalog No. 460.

Carnes also manufactures Round, Rectangular, Square, Convertible and Baseboard Diffusers • Registers • Grilles • High- and Low-Velocity ATC Units • Roof and Wall Ventilators

NEW



NEW

NEW

NEW

CARNES CORPORATION, VERONA, WISCONSIN, / CANADIAN SUBSIDIARY: WEHR AIR EQUIPMENT COMPANY, LTD., 86 GERTIE STREET, WINNIPEG 2, CANADA

FUEL OIL STANDARDS

(Continued from page 10)

greatest significance, Mr. Wright said.

Have Two No. 2's

The chairman stated further that fuel oil uniformity will be a necessity if the oil heat industry is to realize the full potential of new and greatly improved burning systems. It is not practical to readjust the burner setting for each load of oil and it is not yet possible to provide automatic compensating devices, except at prohibitive costs. Also, with more uniform fuel, burner manufacturers like Iron Fireman could build better, less expensive burners that would also be easier to service.

"Probably the most practical solution for keeping up to date in light distillate fuels is to divide No. 2 into two grades, for example, a light grade at 33 to 37 A. P. I. and a heavy grade at 27 to 31 A. P. I.," Mr. Wright said. "Both would be of equal quality and price. The consumer could have his appliance adjusted for best performance with one and specify that grade."

No. 5 Situation "Sad"

Another difficult area, Mr. Wright continued, is No. 5 oil. "The present viscosity range for No. 5 is much too broad to make the standard specification of value without some sort of supplemental specification. Hence, there are a variety of local trade customs by such names as 'Light No. 5,' 'Heavy No. 5,' 'Cold No. 5' . . . and so forth." He observed that too many users of fuel oil unfortunately don't know they should define their needs more closely than by grade number alone. "Hence the reputation for smoke and soot production in our residual oil burning cities," he added.

"It is a sad situation," the Iron Fireman executive commented, "for such a great industry to stand by and let something like this happen. No. 5 is a very desirable fuel when properly handled, but it is being grossly abused."

ELECTED TO NATIONAL OFFICE by Mechanical Contractors Association of America, Inc. at their 72nd Annual Convention, were, left to right: Arthur R. Nagel of the A. R. Nagel Company of Cincinnati, Ohio, as treasurer; Leon L. Munier of Wolff & Munier, Inc., New York City, as senior vice-president; Frank V. McBride of the Frank A. McBride Company, Paterson, N. J., as president. At far left is the immediate past president, Joseph S. Kearney of the Northwestern Heating & Plumbing Co., Chicago, Ill. This year's MCAA convention was held in Miami Beach, May 9-12.

Forty-Three Colleges Name Top Students To Receive Industrial Press Handbook Award

For the third year, The Industrial Press, publishers of *Air Conditioning, Heating and Ventilating* and technical books, has presented an award to the outstanding student in courses involving heating, ventilating and air conditioning in a number of colleges and universities in the United States. The award consisted of a *Handbook of Air Conditioning, Heating and Ventilating* and a Certificate.

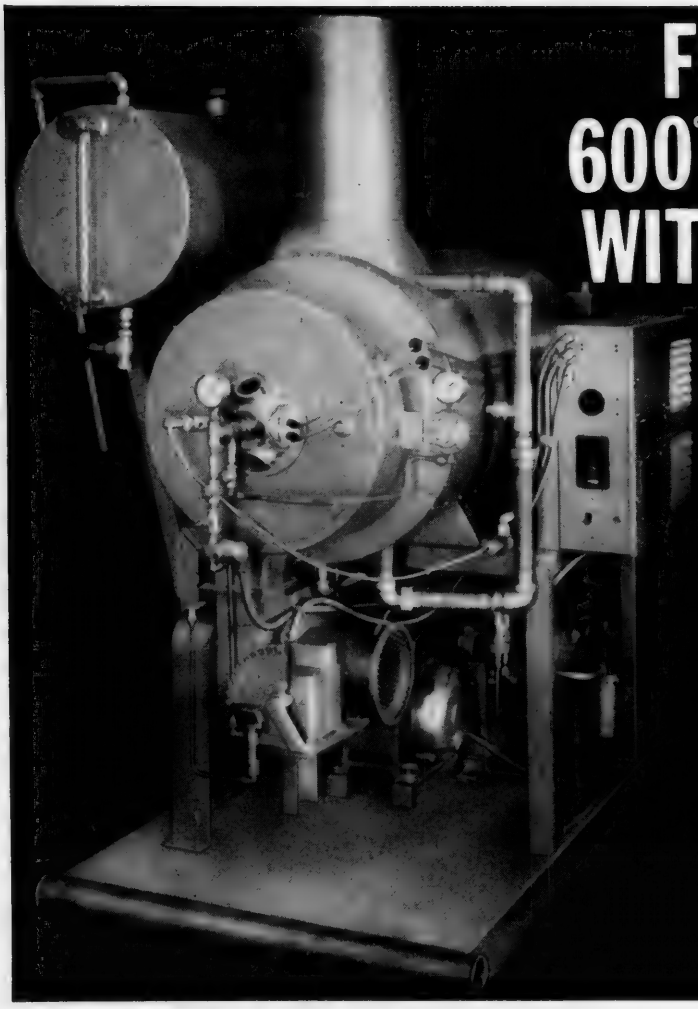
The 43 students who won the award this year are:

W. H. Patterson, Agricultural and Mechanical College of Texas; Gilmore A. Jones, California State Polytechnic College; Glenn D. Allen, Clemson College; David B. Heinzelman, Cornell University; Bryan C. Miller, Duke University; Rodney Dee Wood, Georgia Institute of Technology; Eugene E. Riddick, Howard University; Roland Voth, Kansas State University; Charles E. Beaver, Louisiana Polytechnic Institute; Thomas J. Biesiadny, Marquette University; John L. Cummings, Massachusetts Institute of Technology; John F. Klouda, The Michigan College of Mining and Technology; Bruce J. White, Montana State College;

Allan J. Henderson, North Dakota State University; Randall L. Bartell, Northwestern University; James Eugene Palmer, The Ohio State University; Pankaj Shah, Oklahoma State University; Charles A. Bullock, Oregon State College; Victor J. Dervin, The Pennsylvania State University; Charles E. Dewey III, University of Alabama; Norris P. Sterling, The University of Arizona; Phillip James Bloom, University of Colorado; William H. Snyder, University of Dayton; Victor Melnychenko, University of Delaware; George W. Kelch, University of Florida; Thomas J. Healy, University of Illinois; Charles E. Bullock, University of Minnesota; Roy B. Hedrick, University of Missouri; Leo A. Dilling, University of Notre Dame;

Thomas Parker McCurdy, The University of Oklahoma; George R. Warshel, University of Pittsburgh; Loy M. Ballew, University of Southern California; Charles W. Gray, The University of Tennessee; Antoine F. Smith, The University of Texas; E. W. Weaver, Jr., The University of

(Continued on page 116)



FOR 600° TEMPERATURES WITHOUT ANY PRESSURE!

VAPOR MODULĀTIC

HI·R·TEMP

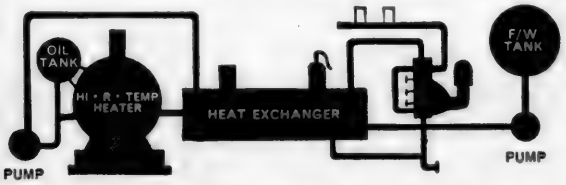
LIQUID PHASE HEATER

This Vapor Modulātic HI·R·TEMP Liquid Phase Heater uses heat transfer aids to provide dependable, automatic, accurately controlled heat transfer to 600° F., without high pressures. Burns natural gas, propane, butane, No. 2 diesel oil, or kerosene. Sizes to 13,000,000 b.t.u.

Check these advantages:

- ACCURATE TEMPERATURE CONTROL. Modulāting controls automatically maintain pre-determined temperature of heat transfer oil.
- NO WATER TREATMENT NEEDED. Eliminates cost of treatment system. No corrosion, scale, freezing problems.
- POSITIVE OIL FLOW. Rotary gear pump assures uniform circulation...prevents hot-spots, coking, sludging, oil breakdown.
- LOW INSTALLATION COST. Completely unitized, skid-mounted with all piping in place. Factory tested before shipment. Compact, lightweight...install it anywhere.
- LOW-PRESSURE VESSELS AND FLOW CIRCUITS. Saves the cost of heavy-duty piping, fittings, valves.
- COLD OIL SEAL. Expansion tank is uninsulated and isolated from main flow of hot transfer oil. Protects oil against atmosphere, sludging, deterioration.
- OPTIMUM SAFETY. Non-toxic. Built to ASME codes. Flame failure, low oil level, high temperature safety shut-off controls are standard. CO_2 quenching ring optional.
- LOW OPERATING COST. Forced-draft combustion, coiled tube design is highly efficient. No high pressures, does not require licensed engineer to operate.

here's how one vapor Hi•R•Temp, with heat exchangers, can supply your needs for processing, heating, hot water, etc.



Heated oil from HI • R • TEMP (at temperatures to 600° F.) passes through heat exchangers to provide steam for processing; at 450° for steam for heating plant and office; at 200° for hot water for cleaning, washing, other uses. Provides full, economical use of heat to lower your operating costs!

VAPOR

For complete information, send coupon today.

Vapor Heating Corporation, Dept. 27-G
80 East Jackson Boulevard, Chicago 4

Please send me Bulletin 4023 on your HI•R•TEMP Liquid Phase Heater.

Name_____

Company_____

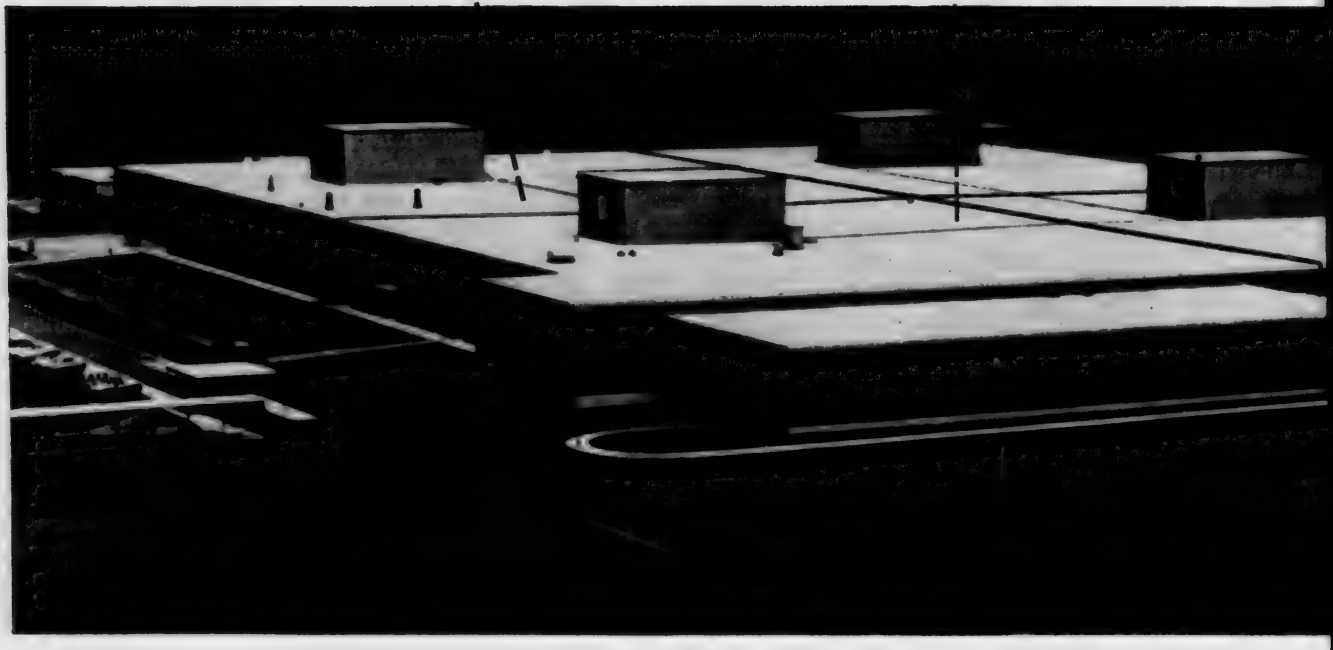
Address_____

City, Zone, State_____

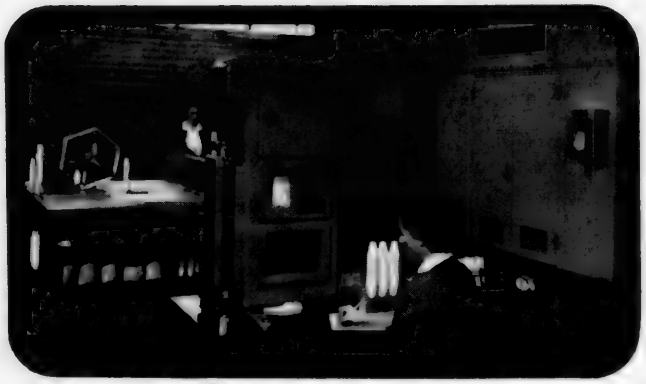
Sales Demonstration. Saco-Lowell machinery is demonstrated in a special sales room. The air conditioning system serving this area can be observed and controlled from this Johnson graphic panel in the sales room.

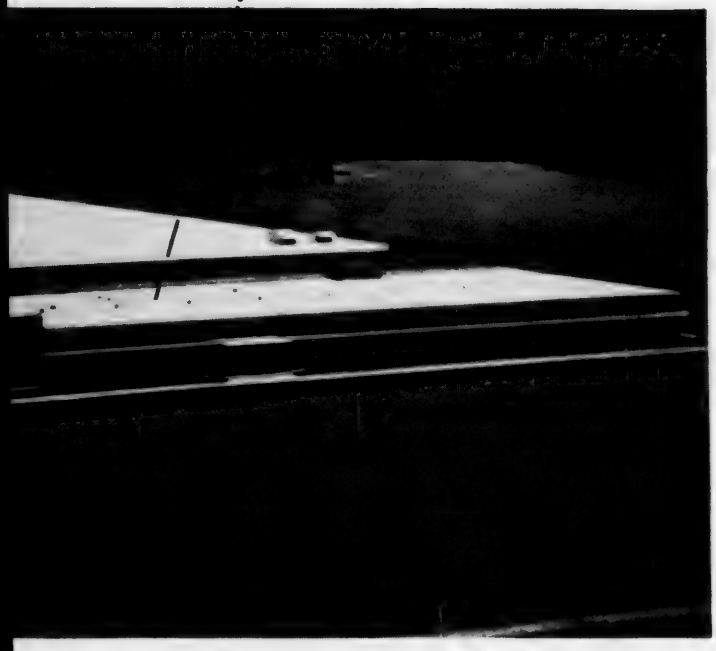
Manufacturing. Johnson Control regulates both temperature and humidity, assures an ideal working climate for employees. Humidity regulation also prolongs equipment life, protects precision machine parts output from damaging condensation and rust.

Laboratory. Fibers produced on Saco-Lowell textile machinery are tested under constant temperature and humidity conditions in accordance with ASTM standards. At right is a Johnson Recorder-Controller mounted in an aspirating cabinet.



CONTROLLED ENVIRONMENT keynotes plant efficiency





Johnson system regulates temperatures and humidities

As the photographs illustrate, controlled thermal conditions are an important asset for production and sales by the Textile Machinery Division of Saco-Lowell Shops, Easley, S. C. The modern air conditioned structure contains over 450,000 square feet of floor space.

A specially planned Johnson Pneumatic Control System maintains the exact temperatures and humidities required for manufacturing, testing, and product demonstrations, as well as for the year 'round comfort of the 1700 plant and office employees.

Here, as in thousands of other Johnson-equipped plants throughout the nation, a controlled thermal environment results in greater productivity, uniformly better product quality, lower costs, and improved worker efficiency.

Johnson Pneumatic Control Systems are applied to all types and makes of air conditioning, heating, and ventilating systems, and to a wide range of industrial processes. Next time you have a problem of temperature, humidity, or pressure control, take advantage of the unmatched performance and lifetime economy features of a Johnson System. Johnson Service Company, Milwaukee 1, Wis. 110 Direct Branch Offices.

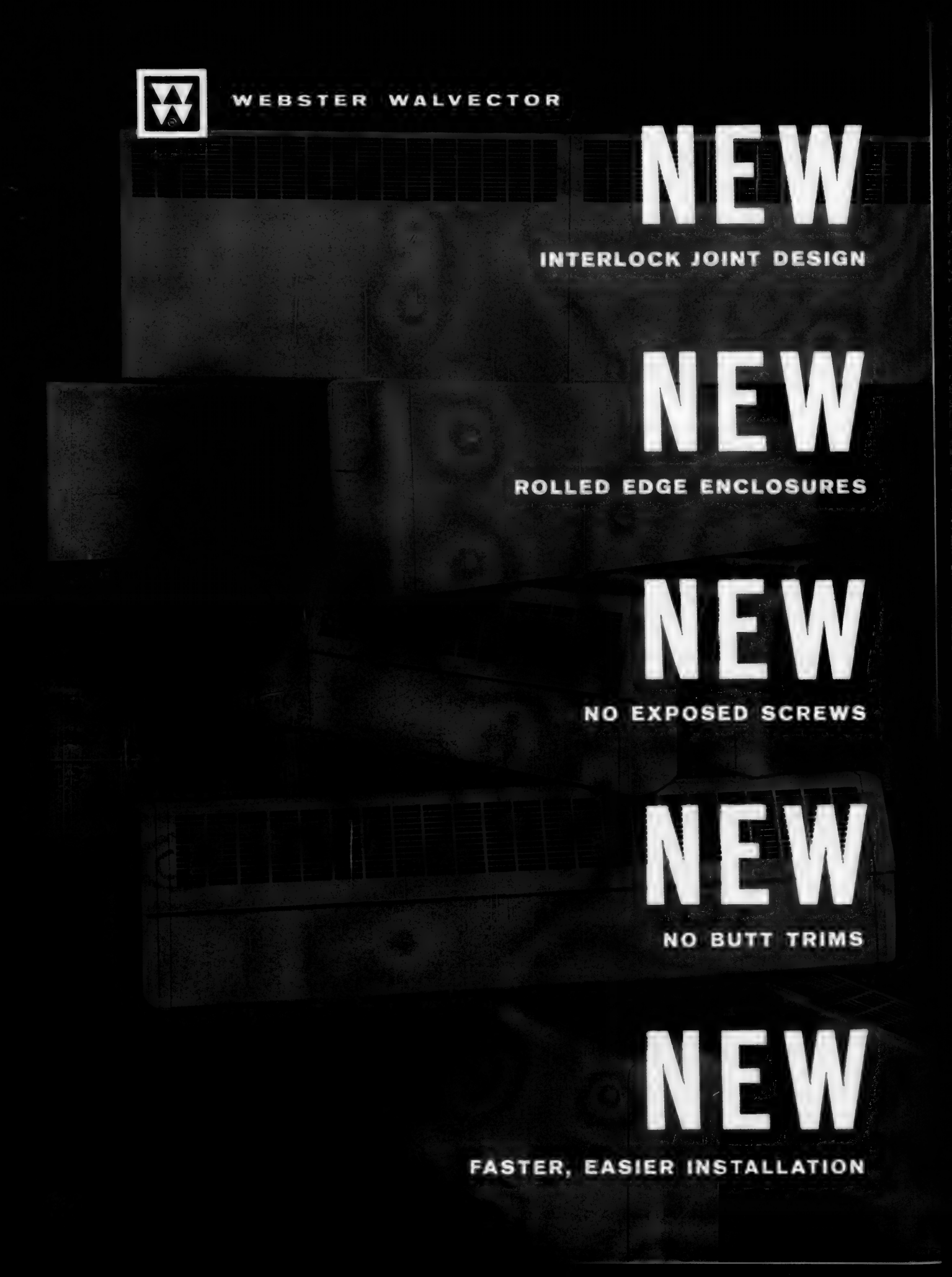
JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

1170

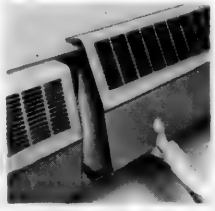
◀ Saco-Lowell Shops, Textile Machinery Division, Easley, S. C.; Lockwood Greene Engineers, Inc., engineers and architects, Spartanburg, S. C.; Daniel Construction Company, Inc., general contractor, Greenville, S. C.; Buensod-Stacey, Inc., mechanical contractor (original project), Charlotte, N. C.; Davis Mechanical Contractors, mechanical contractor (additions), Greenville, S. C.


WEBSTER WALVECTOR
NEW
INTERLOCK JOINT DESIGN
NEW
ROLLED EDGE ENCLOSURES
NEW
NO EXPOSED SCREWS
NEW
NO BUTT TRIMS
NEW
FASTER, EASIER INSTALLATION

ONLY NEW WEBSTER WALVECTOR OFFERS ADVANCED FEATURES IN A COMPLETE LINE OF FIN TUBE RADIATION

Start with the handsome Walvector enclosure. Note the trim look where one length of enclosure joins another. There's no butt trim to install with new Webster Walvector—no unsightly screws required to fasten the joint. New Webster Walvector has *interlock joint*. Sturdy interlock channel welded to the right end of each enclosure interlocks with the rolled *left* edge of the next. Butt trims and metal screws—and the time and labor that goes with them—are eliminated. New Walvector enclosures are rugged *18 gauge steel* with rolled edges at both ends—connect quickly, easily, *securely* to produce an unobtrusively attractive joint structurally reinforced by the interlock channel itself. Interlock Joint is *standard* on all Webster Walvector fin tube radiation . . . enclosures *and* a complete line of trim pieces. End caps, inside and outside corner pieces, access door sections, column enclosures —all are designed with rolled edges and interlock joint to assure clean-line installation for every layout requirement.

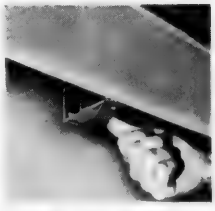
FASTER, EASIER INSTALLATION



SEAT ON TOP CHANNEL

MATE INTERLOCK JOINTS

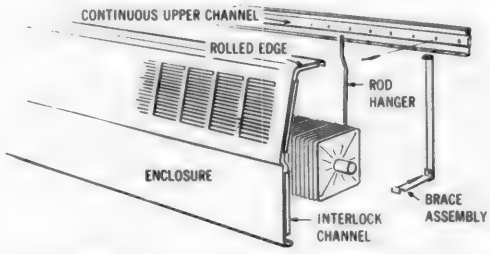
SNAP INTO POSITION



LOCK AT BOTTOM

What's *inside* the enclosure? More new design and construction features to speed and simplify installation of the most efficient Tru-Perimeter radiation for steam or hot water heating systems. Continuous rolled upper support channel on new Webster Walvector, for example, eliminates the need of special gussets for hanging dampers or holding heating element hangers.

Newly designed rod hangers fasten to the upper channel with a friction-type clip which permits easy height adjustment of the heating element. The brace assembly requires fastening to the channel at only one point



. . . fastens to the lower edge of the enclosure with a sure cam-lock-action. Installation of all Walvector components can be readily handled by one man. Nonferrous copper tube and aluminum fin heating element is used in new Webster Walvector. It is light in weight and easy to handle, basic to Webster Tru-Perimeter Heating.

NEW—inside *and* out! Yet hidden features remain unchanged in Webster Walvector. The quality of manufacture and long-service life inherent in Webster products for the past 75 years continues to be your further assurance of reliable, effective comfort heating wherever you install new Webster Walvector. A Warren Webster representative will welcome the opportunity to discuss the advantages of *Webster* Walvector for your application.

NEW: Special packaging saves installation time . . . prevents marring of enclosures.

All "roughing-in" material shipped in advance. Enclosures shipped as required.

SLOPE TOP ENCLOSURE

FLAT TOP ENCLOSURE

DELUXE FLAT TOP

CUSTOM WALVECTOR

WARREN WEBSTER & COMPANY, INC.

CAMDEN 5, NEW JERSEY

Compare! In centralized control panels, Honeywell

YOU GET A CUSTOM JOB

Three new standardized panel lines manufactured entirely by Honeywell assure uniformity, quality, fast delivery, minimum cost

Now you can have a centralized control panel built to your exact specifications, and not wait months for delivery. Honeywell's new standardized units can be combined any way you like to give you a truly *custom* job. And because sizes and construction techniques have been standardized, you get the same high quality and uniformity every time, with fast delivery and at a minimum cost. You'll also find them much easier to specify!

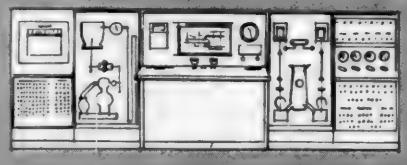
Most important, all Honeywell panels are manufactured entirely by Honeywell in a complete, experienced panel factory. Nothing is jobbed out—no delays because of dependence on outside sources. You're assured of famous Honeywell quality control every step of the way—design, engineering, steel work, painting, engraving, assembly, wiring and, of course, all controls. *Only* Honeywell backs its control panels with such all-the-way production and service! For details, call your nearby Honeywell office. Or write Honeywell, Dept. HV-7-140, Minneapolis 8, Minnesota.

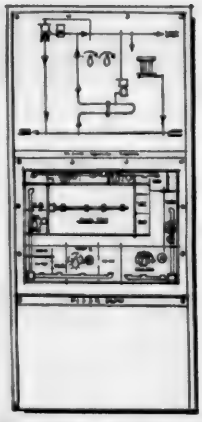
1

Honeywell
Selectographic DataCenter*

A whole new concept in system-by-system operation. Builds together block by block. The console enables one man to supervise an entire air conditioning system in a building or group of buildings from a single set of compact controls. Built around the console, in 2'x4' or 2'x2' modules, can be permanent system diagrams with pilot lights, alarm signals, instruments and switches; system analyzers; alarms; and controls for other phases of the buildings' mechanical operation. The console itself is 48" wide x 52" high.

Fit units together in any combination!

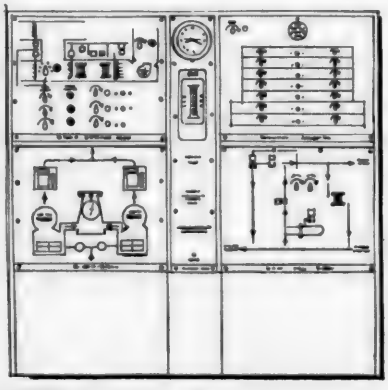




Specify whatever controls you need!

2 Honeywell
Supervisory DataCenter*

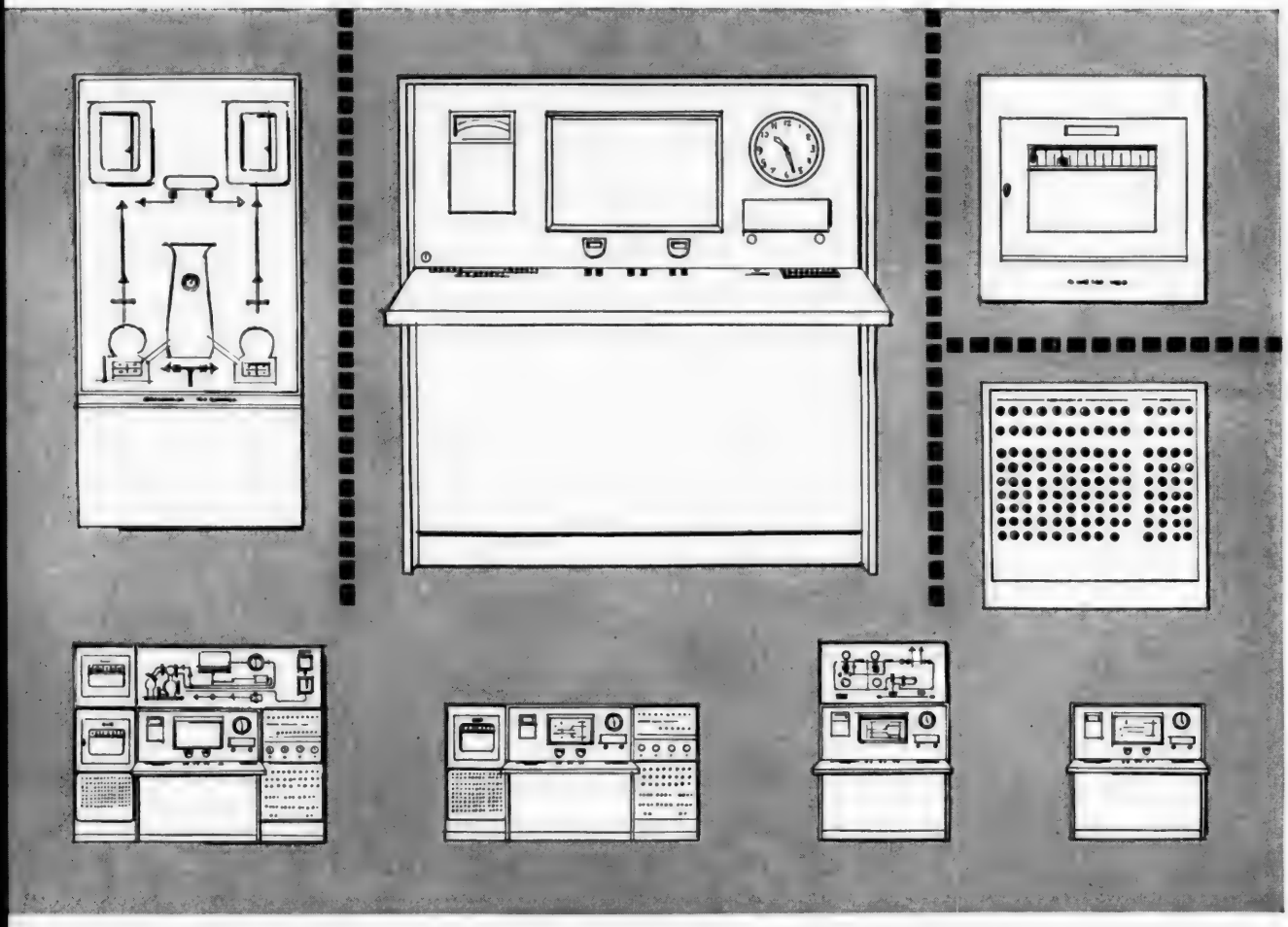
Standardized panels, with system diagrams permanently engraved and color-coded under durable Plexiglas. Highly suited to buildings with relatively few fan systems, or where numerous systems with identical layouts permit use of one diagram for all, with an accompanying panel of pushbuttons and adjustment knobs. Offers the same optional features as the Selectographic. Outside dimensions of the module at left are 36" wide x 84" high.



Modular design gives building block flexibility!

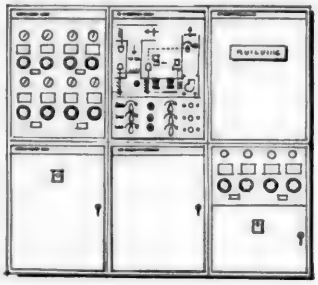
engineering makes the difference

FROM STANDARD UNITS!

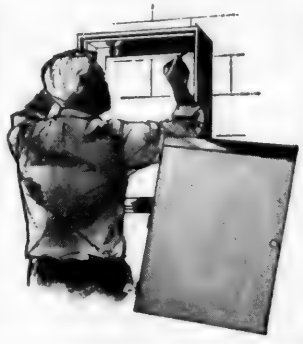


3 Honeywell Fan Room Panels

Pre-planned for step-by-step installation. When time comes for roughing-in, Honeywell ships just the ring frame. Knockouts in the rings permit easy wiring connections between the units, using factory-wired plugs. When needed on the job, the controls are shipped factory-mounted on a subpanel that forms the back of the cabinet and, when suitable, on the door. Panels are light, immediately available, easy-to-mount, and safe from damage. Ring frame is 24″ wide x 32″ high.



New two-part shipment!



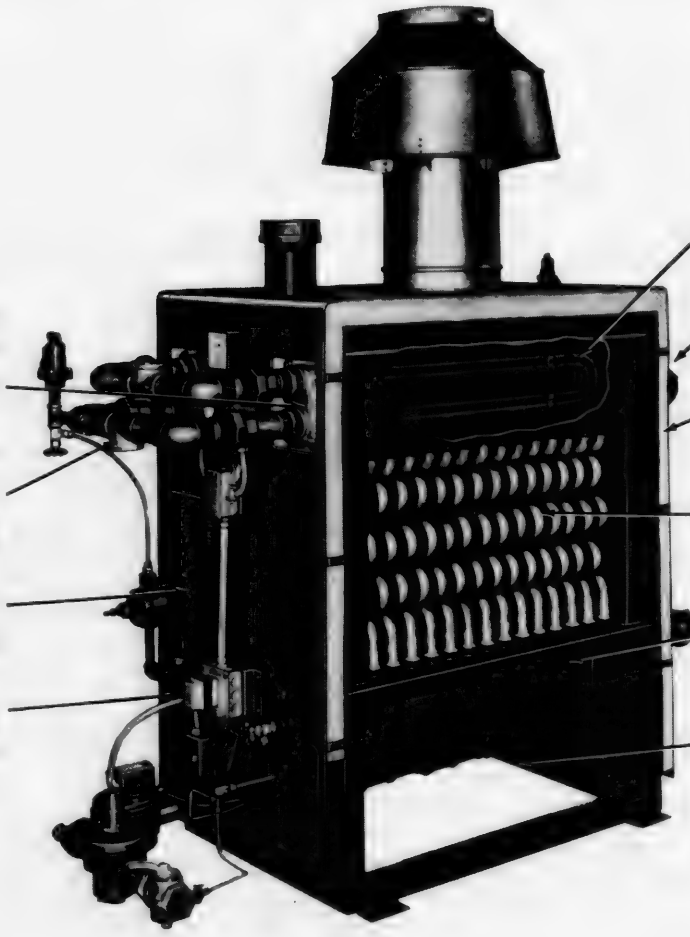
Honeywell

*Trademark

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.



Heavy gauge copper indirect heat exchanger tubes to transfer heat from boiler water to process water.

Interior of boiler easily accessible.

Thick Fiberglass insulation, an integral part of the heater jacket.

Bryan 1" O.D. copper tubes, acting as primary heat exchanger between combustion heat and boiler water.

Heavy steel plate boiler frame, built and stamped in accordance with ASME Boiler Code.

Oil burner combustion chamber or gas burner assembly completely exposed by removing jacket side.

Heavy bronze heat exchanger heads, bolted to boiler frame, can be easily removed to clean or replace.

With the larger units two separate heat exchangers are used. These are connected with brass headers.

16 Gauge rust resistant, high tensile strength alloy steel jacket.

All controls, gauges and tappings at boiler front for ease in servicing.

deliver

110°
140°
180°

water

with one Bryan indirect water heater system

Where more than one water temperature is required, a single Bryan Indirect Water heater does the job, saving space, economizing on fuel and greatly reducing service. Gas or oil fired Bryan Boilers in sizes from 125,000 BTU to 2,250,000 BTU meet multiple water heating requirements for restaurants, laundries, soda fountains, hospitals, institutions, apartments, schools, industry, motels, packing plants, and swimming pools.

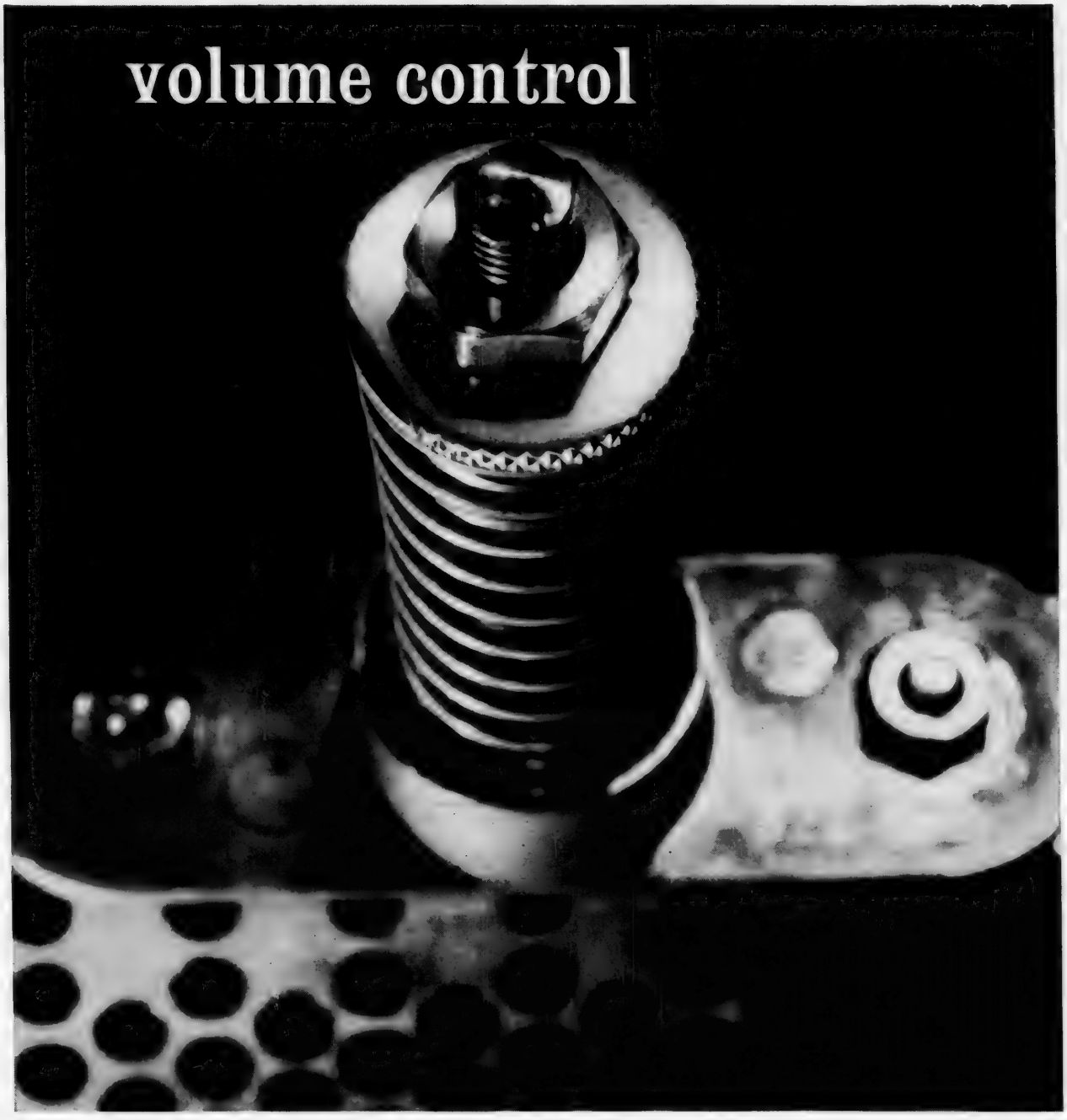
Bryan Boilers
COPPER TUBE

Complete specifications in Form 630
Write for your FREE copy.

Bryan Copper Tube Boilers are designed and built to the requirements of the A.S.M.E. Code. Gas-fired models A.G.A. approved.

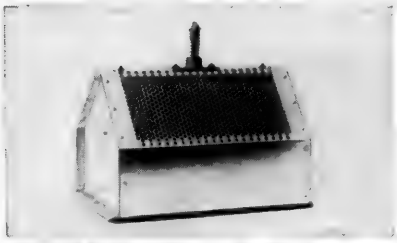
BRYAN STEAM CORPORATION • Peru, Indiana

volume control



All it takes is a turn of this knurled nut to adjust a Buensod Dual Duct air mixing unit for the exact air volume desired. (The smaller nut locks the adjustment.) And constant volume is maintained ±5% regardless of static pressure variance. There's never a problem of system balancing, no sudden blasts or cut-down due to operation of other zones in the system.

Dual Duct high velocity air conditioning fits new structures or renovations with equal ease. Consider this advanced, year-'round system for inclusion in your next project.



This tent-like apparatus is the heart of Buensod's Automatic Volume Control.

BUENSOD-STACEY CORP. · MANUFACTURED PRODUCTS DIVISION

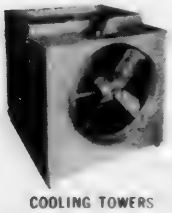
BUENSOD-STACEY

45 West 18th Street · New York 11, N. Y. · Subsidiary of Aeronca Manufacturing Corporation

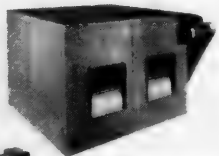
want to save on job costs?

specify these dependable Halstead & Mitchell products:

PRODUCT	SERIES	TYPE	NOMINAL TONS	WRITE FOR BULLETIN
COOLING TOWERS with an exclusive 20-Year Guarantee on the wetted deck material against failure due to fungus attack or rotting.	EC	Standard • Propeller fan • Belt drive	5 to 150	EC-500
	ECK	Take-Apart • Propeller fan • Belt drive	5 to 100	EC-500
	ECD	Residential • Propeller fan • Direct drive	2 to 7½	EC-500
	ECKB	Standard or Take-Apart • Centrifugal fan • Belt drive • Horizontal or Vertical discharge	5 to 30	ECKB-601
WATER-COOLED CONDENSERS Mechanically cleanable, condensers are of double-tube, true counterflow design for extra liquid subcooling.	EL	Standard for small commercial refrigeration	⅓ to 3	WC-300
	WR	Multi-Section for larger commercial refrigeration	2 to 7½	
	R	Close-coupled for packaged air conditioning	1½ to 10	
	T	Heavy duty for poor water conditions	⅓ to 25	
	SW	Sea water and corrosive water usage	⅓ to 25	
AIR-COOLED CONDENSERS Wide fin spacing won't clog quickly. Casings are rugged; won't rattle or loosen. Use with a Limitrol valve for year-round operation. Multiple circuiting at no extra cost.	AC	Propeller fan • Horizontal discharge • Belt drive	3 to 100	AC-102
	ACV	Propeller fan • Vertical discharge • Belt drive	5 to 100	
	BC	Centrifugal fan • Belt drive	10 to 30	
	ACR	Residential model • Centrifugal fan • Cabinet has space for compressor and controls	2 to 7½	
FINNED COILS Turbu-Flo® fins for better air wash. Aluminum fins, copper tubing. (Copper fins to order.) Heavy-gauge galvanized steel casings (or aluminum). Cleanable tube water coils to order.	DE	Direct expansion coils for Refrigerants 12, 22 and 500	Standard is 7 fins per inch. Available in 6, 8, or 10 FPI on order. Finned heights of 12 to 36 inches. Finned lengths of 18 to 120 inches. 1 to 8 rows deep. Other sizes to order.	DE-200
	CWC	Chilled water coils		CWC-202
	HWC	Hot water coils		HWC-201
	S	Standard steam coils		S-200
	NFS	Non-freeze steam coils • Steam distributing tube type		
AIR HANDLERS Large centrifugal fans in a heavy-gauge cabinet of formed post members, flush mounted panels. Space for up to 12 rows of coil depth; 2 to 68 sq. ft. of face area.	AH	Suspended type	3 to 120 tons at std. conditions of 880 to 47,500 CFM at 400 to 700 FPM; up to 2" W.G.	AHU-100
	VAH	Floor mounted type		

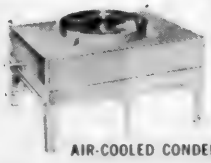


COOLING TOWERS



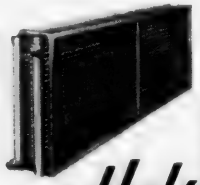
AIR HANDLERS

WATER-COOLED CONDENSERS



AIR-COOLED CONDENSERS

FINNED COILS



HM Halstead & Mitchell

HALSTEAD & MITCHELL CO. · BESSEMER BUILDING · PITTSBURGH 22, PA.

PPG Fiber Glass Pipe Insulation is quickly installed, provides top thermal insulation at Fontainbleau Towers addition in Miami Beach. 100,000 ft of this insulation was used, as well as PPG Duct Liner and Duct Insulation.

"We chose PPG Fiber Glass Insulation Materials because they are easier to handle than any other insulation products"

. . . says Mr. Joseph Crabtree, President, Crabtree Insulation Company, Miami, Florida

Crabtree Insulation Company had the contract to install all pipe and ductwork insulation in the new 405-room addition to Fontainbleau Towers, Miami Beach. Choice of materials was given to the company.

Mr. Crabtree asked his superintendent what materials he felt should be used, and was advised that the men preferred PPG Fiber Glass Insulation Products because they were easier to handle.

As a result, Crabtree Insulation Company used 100,000 ft of PPG Pipe Insulation, 25,000 ft of PPG Neoprene-coated Duct Liner, and 25,000 ft of PPG Duct Insulation in the new Fontainbleau Towers addition.

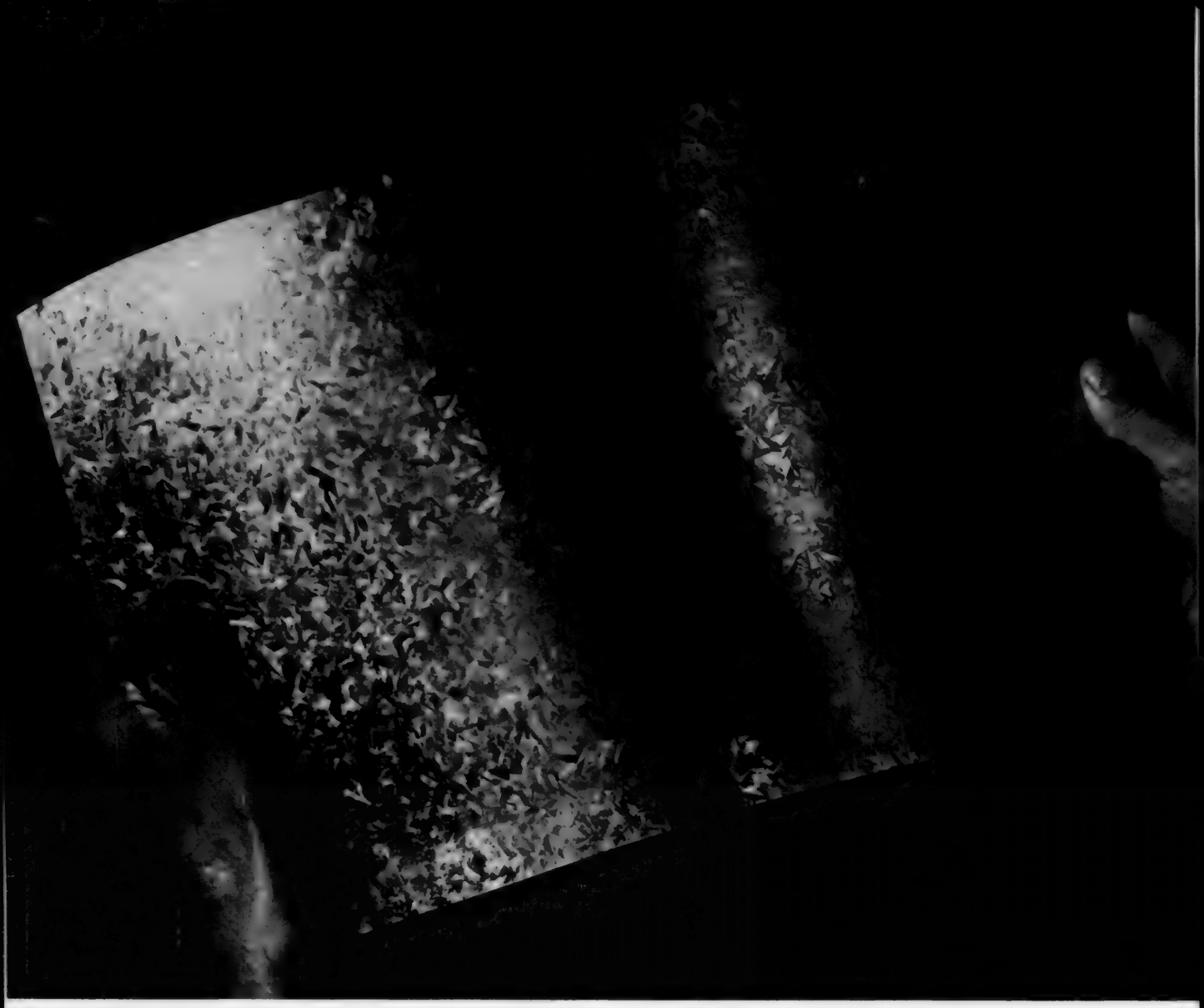
Mr. Crabtree reports the insulation job went faster and with fewer problems than if other materials had been used. On the basis of this job and other jobs where he had used PPG materials, he would recommend PPG with no hesitation to other contractors.

WANT TOP RESULTS? TRY PPG!

PPG has a wide range of fiber glass thermal and acoustical insulation products that speed installation, provide excellent insulating properties, give long service life with little or no maintenance. If you haven't tried them, get full information by contacting your nearest PPG Fiber Glass Sales Office, or by writing *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

FIBER PPG GLASS | PITTSBURGH PLATE GLASS COMPANY

Sales Offices: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Houston, Kansas City, Louisville, Los Angeles, Miami, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis and Seattle.



Bethcon Galvanized Steel Sheets

have ideal ductility and stiffness for ductwork

Make your own test. Get a piece of Bethcon and flex it back and forth a few times. Notice the snap and life? That means easy forming, and a strong and rigid end product.

Special Annealing Does It

There's a sound metallurgical reason for Bethcon's "extra something." A special annealing cycle in Bethlehem's continuous galvanizing lines gives Bethcon its very desirable characteristics. And the zinc is deposited on the sheet so tightly that even the toughest forming and bending will not crack the coating.

Send for Sample Sheets

You can specify Bethcon in a wide variety of gages and widths, coiled or in cut lengths. The base metal can be either plain open-hearth steel or copper-bearing (Beth-Cu-Loy). A Bethlehem representative will be glad to supply samples and detailed information. Or write us at Bethlehem, Pa.

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for Strength
. . . Economy
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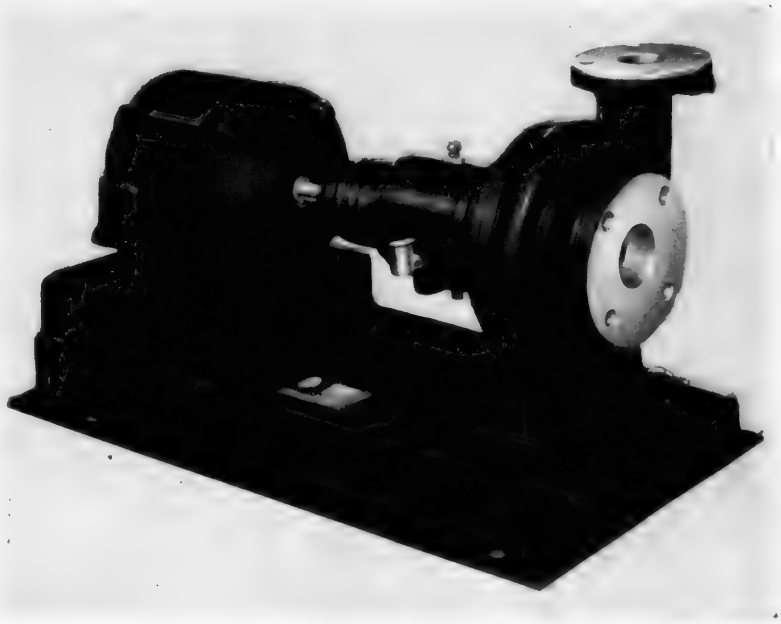
prove it to yourself!

...THAT THE SERIES 1510-B CENTRIFUGAL PUMP OFFERS MORE



1510-B FEATURES

- Vertical split case design—solid-type volute can be left in pipe line when servicing pump.
- Removable bearing frame assembly—can be lifted out without disturbing piping or motor leads.
- Interchangeable bearing frame assembly—one unit fits a wide range of pump sizes.
- Positive oil lubrication with visual check.
- Anti-friction *roller bearings.*
- Mechanically balanced impeller. Balancing chamber and pressure relief holes in impeller reduce thrust to a minimum—lengthen pump life.
- Leak-proof "Remite" seal. Carbon seal ring faces on harder-than-glass Remite floating seat. Assures long, trouble-free life.
- Special alloy steel shafts, superfinished, oversized.
- Performance guaranteed—100% pre-tested at the factory for conditions of head and capacity specified.
- Choice of all-iron, bronze-fitted, or all bronze.
- Capacities to 2000 GPM, heads to 420 ft.

Why not get your full dollar's worth of pump value...send today for selection data on the B&G 1510-B Centrifugal Pumps.

Check any centrifugal pump of comparable capacities against B&G 1510-B Pump features!

B&G Series 1510-B Centrifugal Pumps are distinguished by all the features listed at left. To compare any other pump with the 1510-B, place check marks in the red boxes beside the features also offered by the competitive pump.

We'll wager you'll wind up with quite a number of unchecked boxes!

The balanced design of this *vertical split case* pump is definite assurance of smoother, more efficient performance and longer life. Its design enables the bearings to withstand loads far in excess of those produced by any pump and motor combination in the 1510-B series ...an added feature of dependability.

NOW AVAILABLE IN "C" SIZE UNITS
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2000 GPM, 170 feet, 1750 RPM,
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to people who hear voices*

*voices that intrude or disrupt and noises that project when they should be hushed

The new Aircoustat® Model W Return Air-Vent Silencers stop the transmission of noise without blocking air flow

Aircoustat Return Air-Vent Silencers eliminate the distracting sound of voices that spill from one area to another. Their slim design gives you a choice of installation. You can install them within a wall or ceiling or hang them on doors or walls. Let Koppers long experience in sound control help you. Write today for information to: KOPPERS COMPANY, INC., 2907 Scott Street, Baltimore 3, Maryland.

Model W Return Air-Vent Silencer

In sizes for all applications:

Model	Thickness	Width	Length
W-1	3½″	30″	48″
W-2	3½″	42″	48″
W-3	5″	30″	48″
W-4	5″	42″	48″
W-5	7″	30″	48″
W-6	7″	42″	48″

KOPPERS

SOUND CONTROL
METAL PRODUCTS DIVISION
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wit
TY "5" COIL

any size
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any material

for water, steam, direct expansion or special fluids

McQuay means Quality

The new McQuay Type "5" coil design offers you a new high in fin efficiency by attaining the highest heat transfer rate possible without excessive air friction. The combination of equilaterally staggered tubes and modified rippled fins produces a maximum of air turbulence to interrupt the insulating boundary layer film and still retain the intimate and prolonged contact between air and the heat exchanger surface.

Each Type "5" coil features practically an unlimited flexibility in selection of coils to more accurately meet load requirements. Standard coils are furnished with copper headers and flow-controlled circuiting to assure the turbulent fluid flow necessary without using restrictive internal devices.

For any coil requirement, look to McQuay. Call your local McQuay representative or write to McQuay Inc., 1619 Broadway N. E., Minneapolis 13, Minnesota.

THE NATION'S LARGEST COIL MANUFACTURER

SELECT McQUAY STANDARD COILS FROM ANY COMBINATION OF THE FOLLOWING:

Single Serpentine . . . . . One to 14 fins per inch
Half Serpentine . . . . . From 6" through 36" high face
Double Serpentine. . . From 6" through 144" nominal tube length

ALSO AVAILABLE IN SPECIAL CIRCUITS, FIN SPACINGS, SIZES AND MATERIALS

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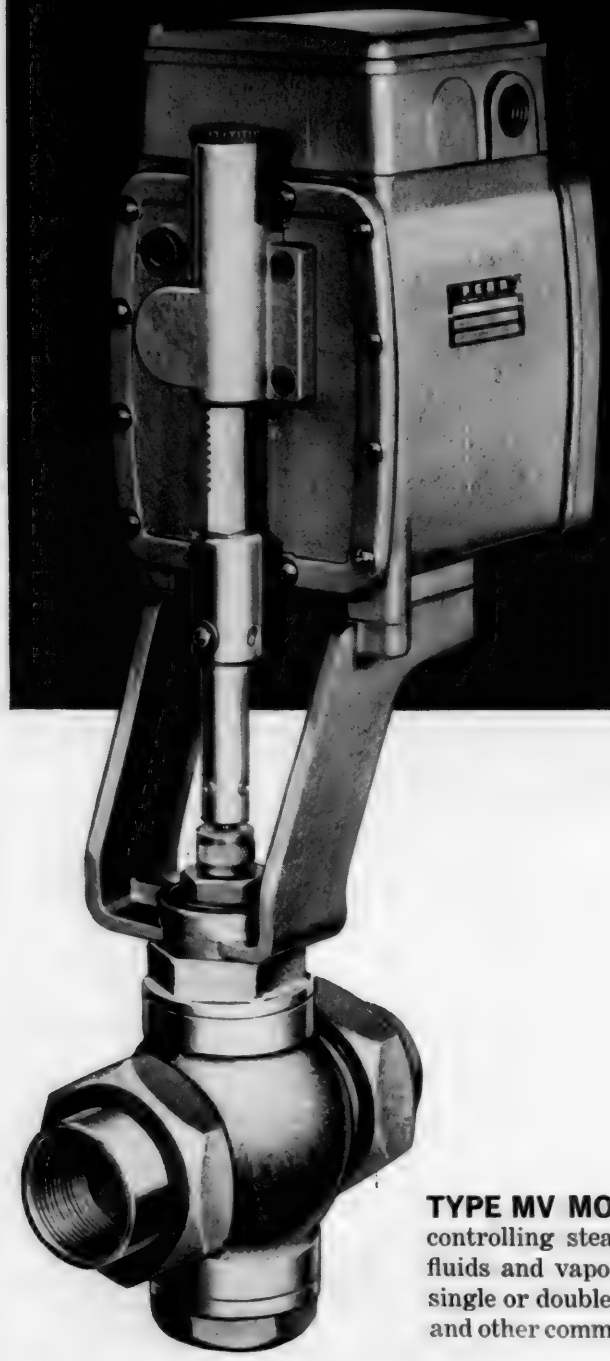

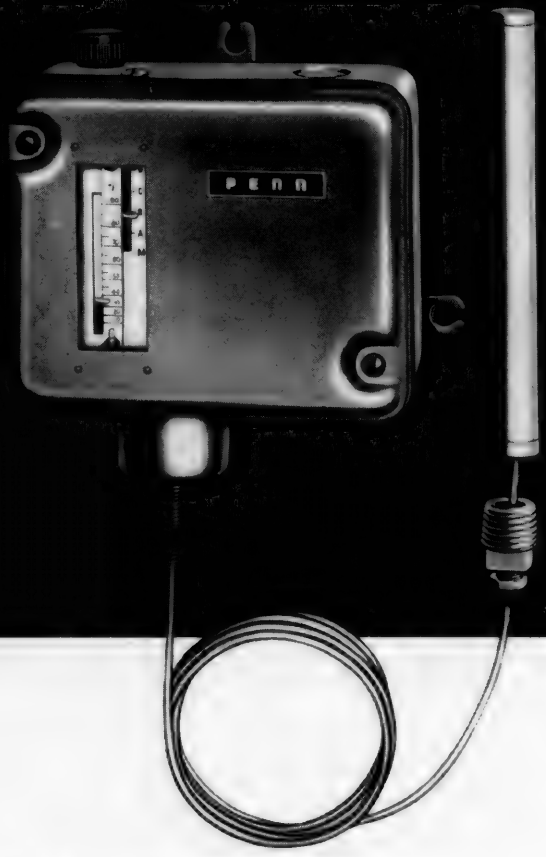

TYPE TB TEMPERATURE CONTROL with adjustable throttling range for accurate control of air and liquid temperatures in heating, air conditioning, industrial process and ventilating applications.

TYPE MV MOTOR ACTUATED VALVE for controlling steam, water, air, gas, oil and other fluids and vapors. The line includes two-way . . . single or double seat . . . three-way, pilot balanced, and other commonly used types.

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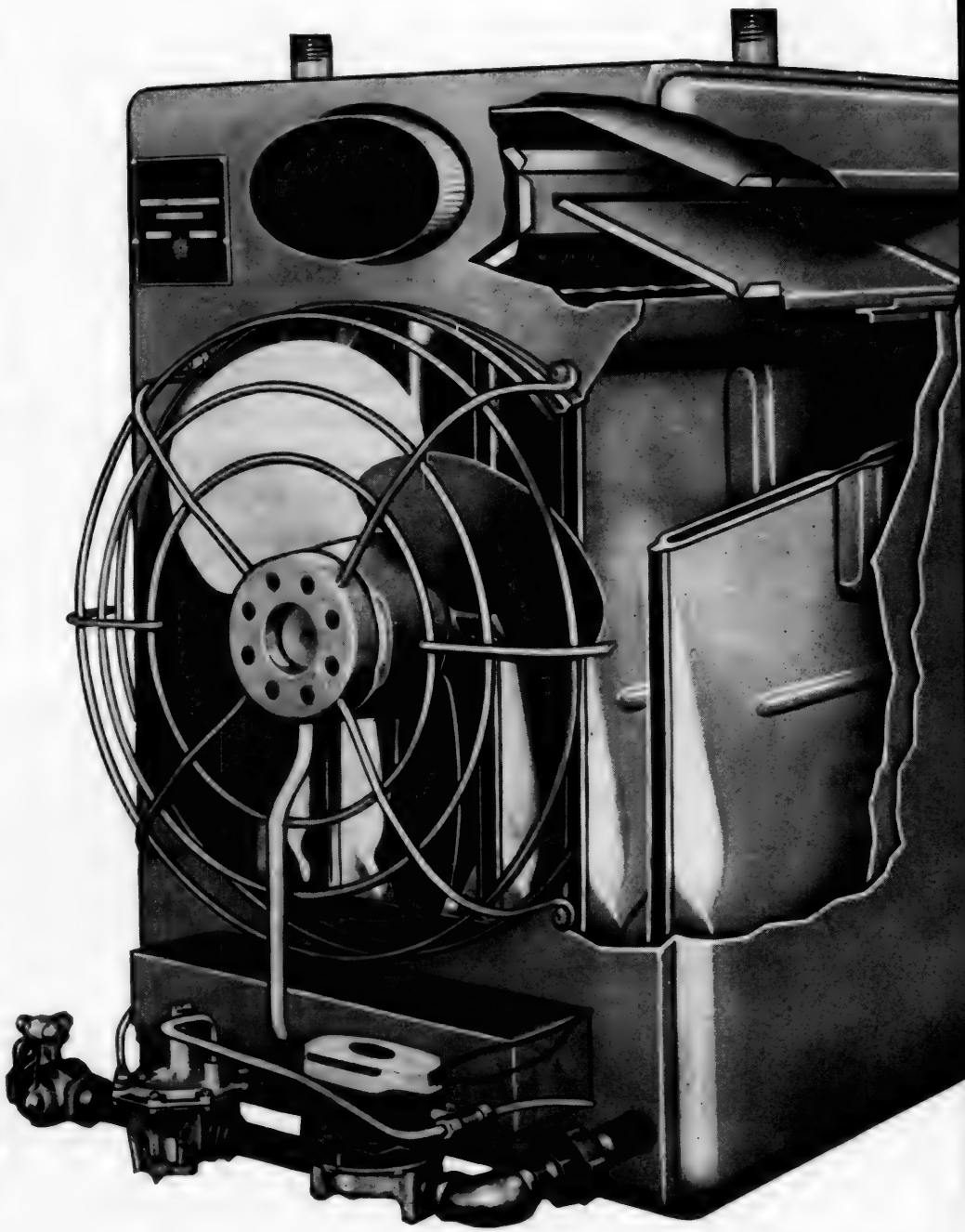


MARSH PACKLESS RADIATOR VALVES

WHEEL HANDLE

GRADUATED

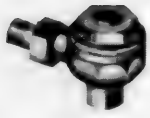
LOCK AND SHIELD

ANGLE PATTERN

GLOBE PATTERN

CORNER PATTERN (Sectional Below)

MARSH THERMOSTATIC RADIATOR TRAPS



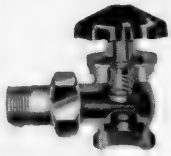
ANGLE PATTERN

STRAIGHTWAY PATTERN

VERTICAL PATTERN

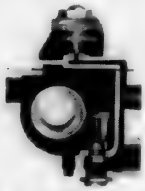
LEFT HAND CORNER PATTERN

RIGHT HAND CORNER PATTERN



CUT OPEN VALVE

F&T TRAPS

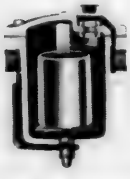


No. 12, REPRESENTATIVE OF WIDE LINE

VENTS

No. 5 VENT, ONE OF MANY

BUCKET TRAPS



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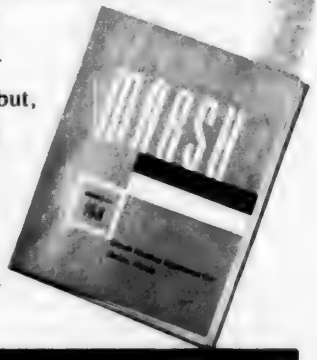
All the best of their kind!

You probably have made certain Marsh products your standbys without realizing there are a lot more of them just as superlative as the ones you like so well.

Make the acquaintance of some of them here, but, better still—***Ask for this Marsh Catalog!***



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Practical field help is also provided. Questions relating to proper system design, product selection, installation and servicing of Weil-McLain heating equipment are handled promptly by the Technical Services Department. In the Weil-McLain School of Better Heating, classes in the design and installation of modern hydronic heating systems are regularly conducted for contractors and wholesalers.

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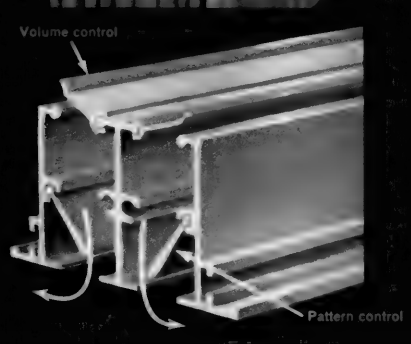
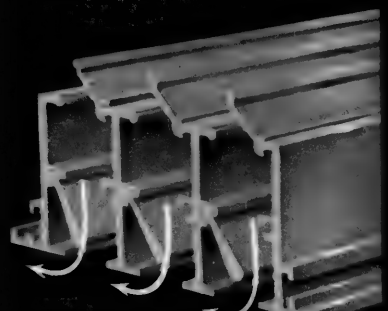
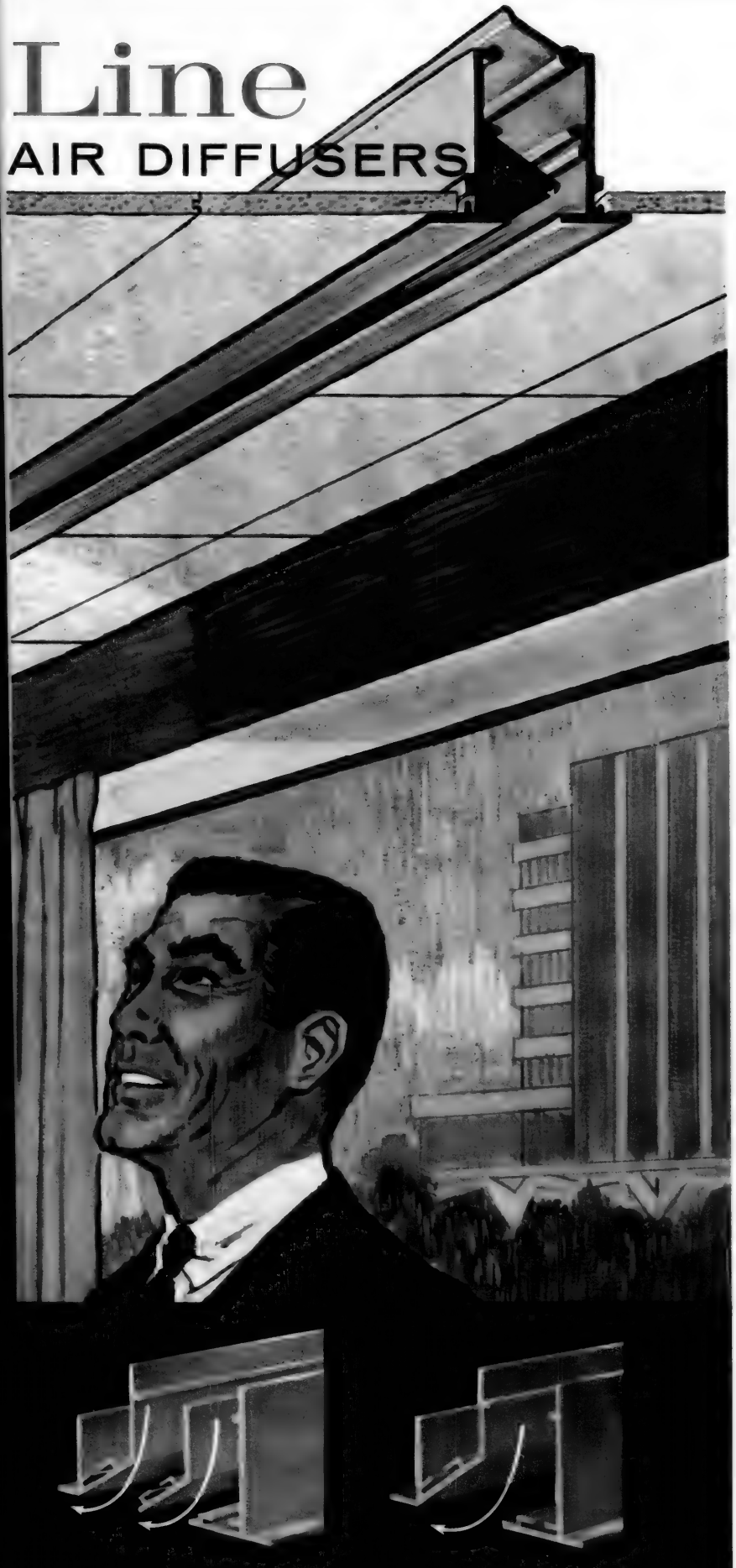


CLA two-slot Control-Line diffuser with volume control and two-way opposite pattern control



CLA three-slot Control-Line diffuser with volume control and one-way air pattern control

Line
AIR DIFFUSERS



CLF two-slot Control-line diffuser with one-way fixed air pattern

CLF one-slot Control-Line diffuser with one-way fixed air pattern for recessed corner mounting

. . . independent control of air volume and pattern insures comfort

You get everything the name implies in a Barber-Colman *Control-Line* extruded aluminum air diffuser — linear design distinction with built-in control of both air volume and pattern.

These diffusers are light in weight, easy to handle, and simple to install in ceiling, sidewall, or soffit. They are assembled in continuous lengths by mechanical interlocking, using a key-and-slot arrangement. This assures continuity and alignment.

Available with one, two, three, or more linear openings, with built-in volume controls. Completely flexible CLA models incorporate air pattern adjustment — from horizontal to vertical throw. Can be furnished for two-way opposite or one-way air delivery as required.

The CLF models provide fixed air pattern delivery and are available in various shapes and styles to meet all architectural requirements. They may be used for any supply or return air application.

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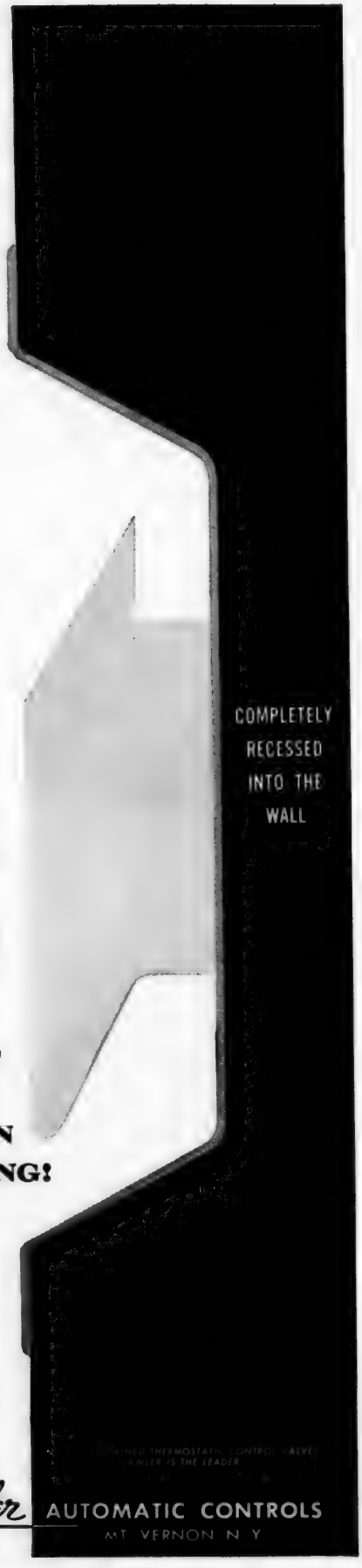

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An All Ambient

* *Experiencing nuisance trip-outs when operating your air cooled condensing unit below 60° F outside?*

* *Desire an air cooled condensing unit that assures consistent operation in outside temperatures to 120° F?*

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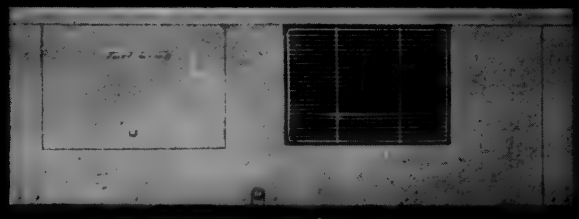
* *Concerned about dangerous freon migration during low outside ambients?*

* *Looking for an all ambient air cooled condensing unit to meet your humidity control requirements?*



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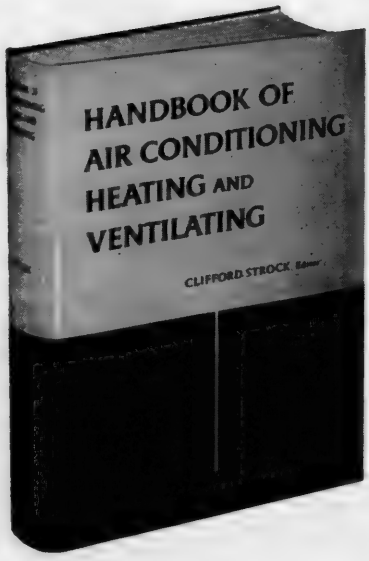

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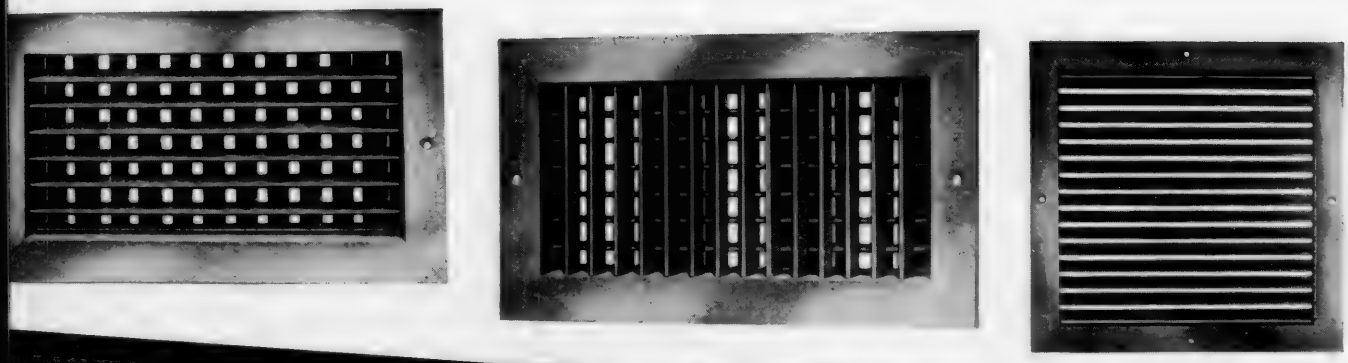

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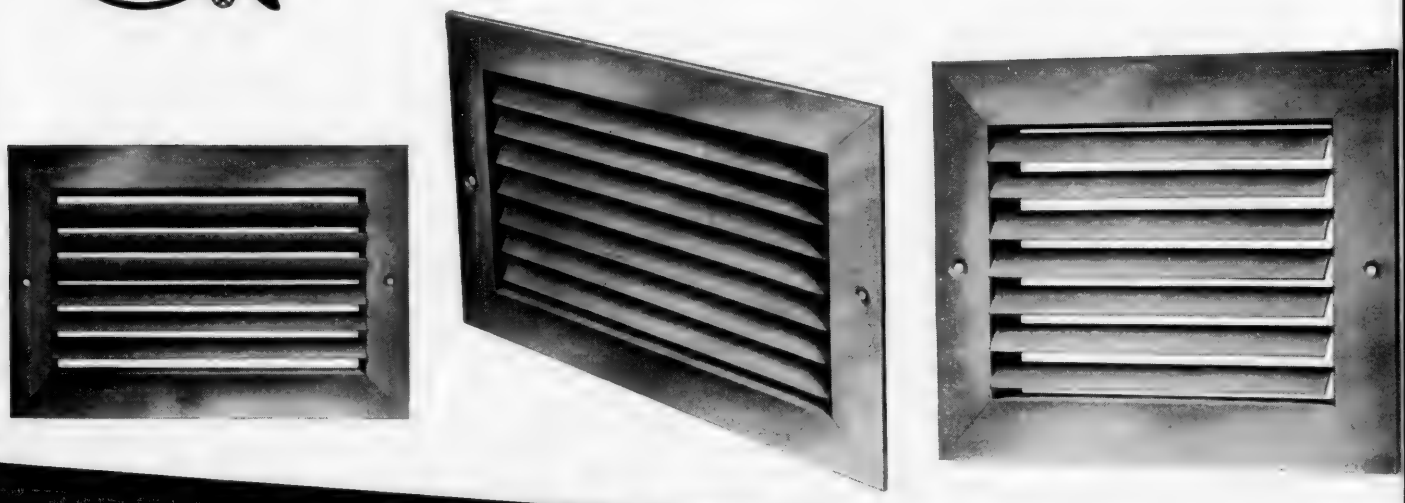

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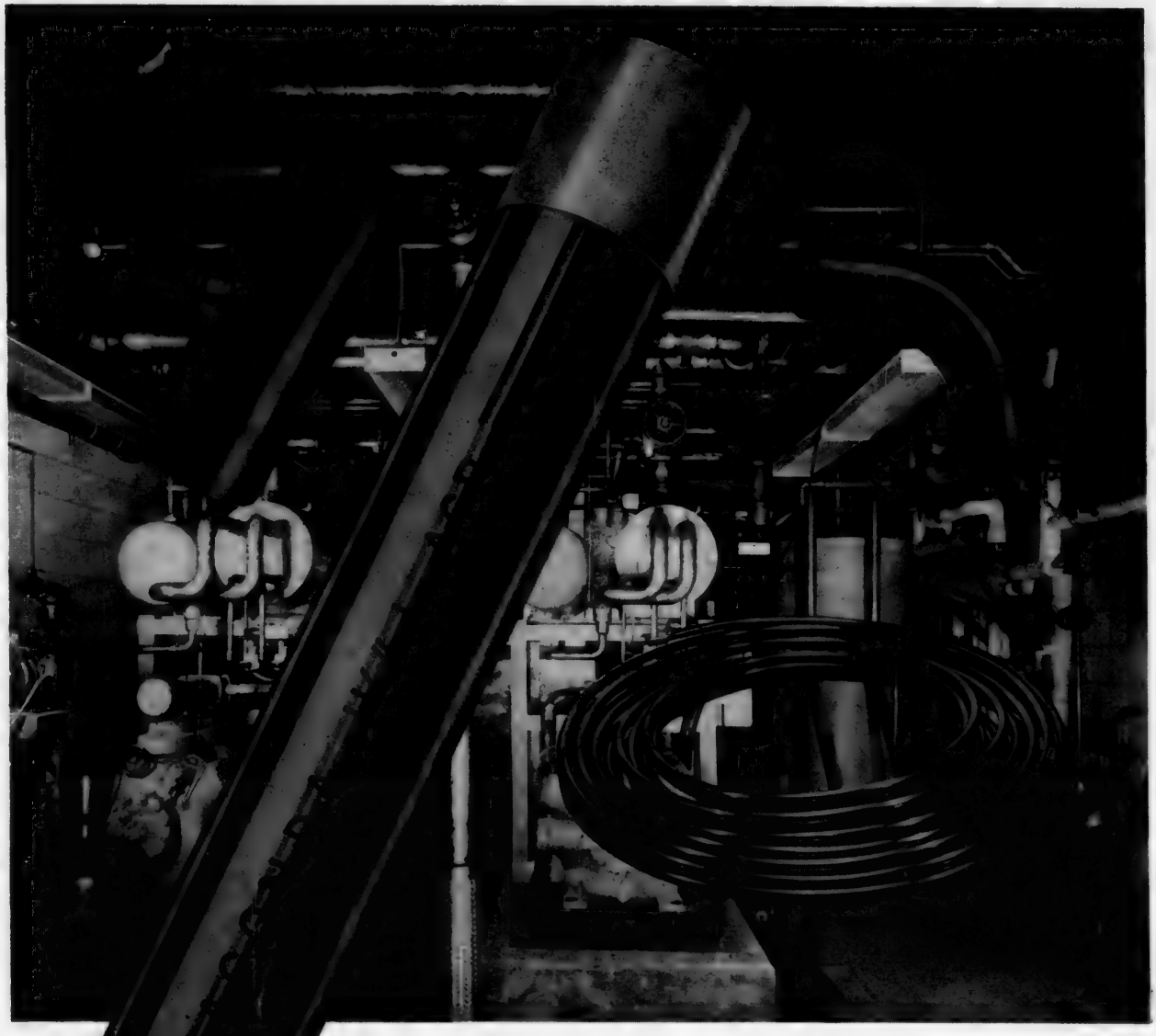

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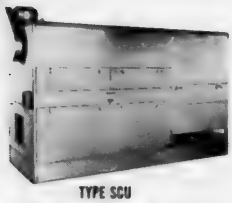

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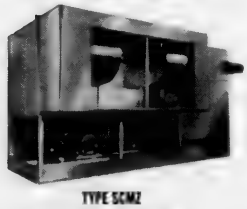

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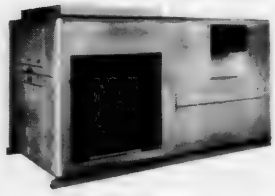

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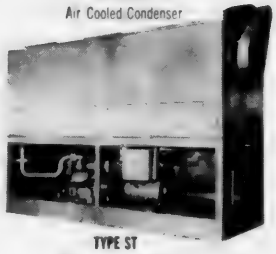

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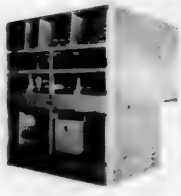

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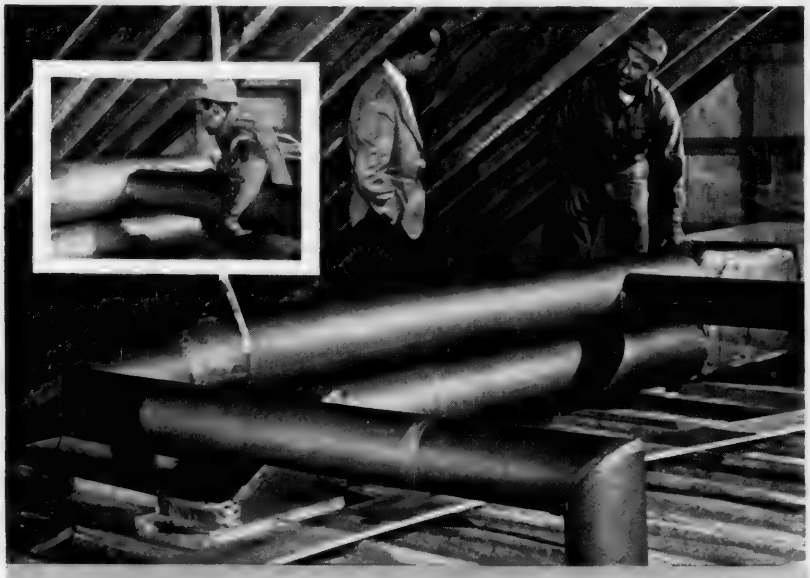

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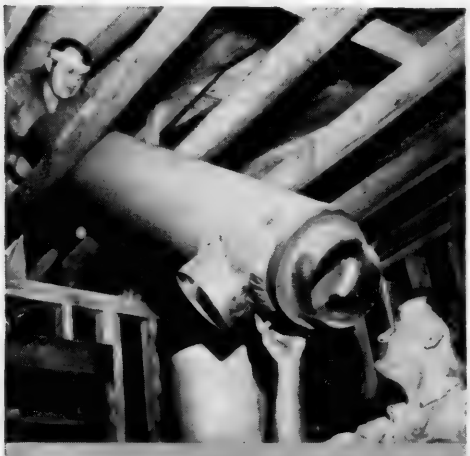

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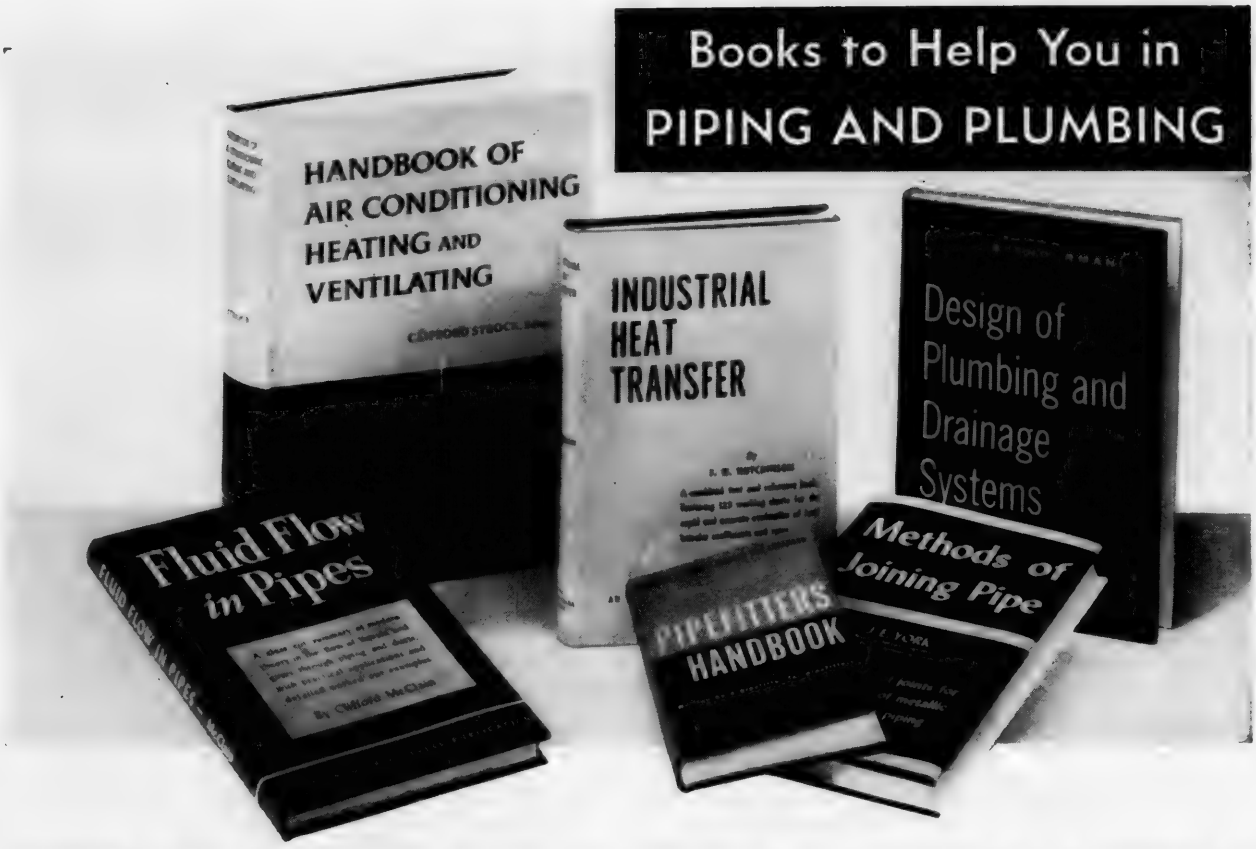
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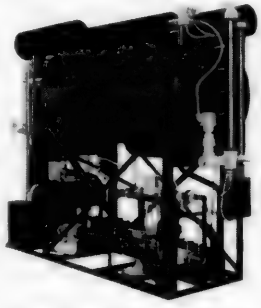

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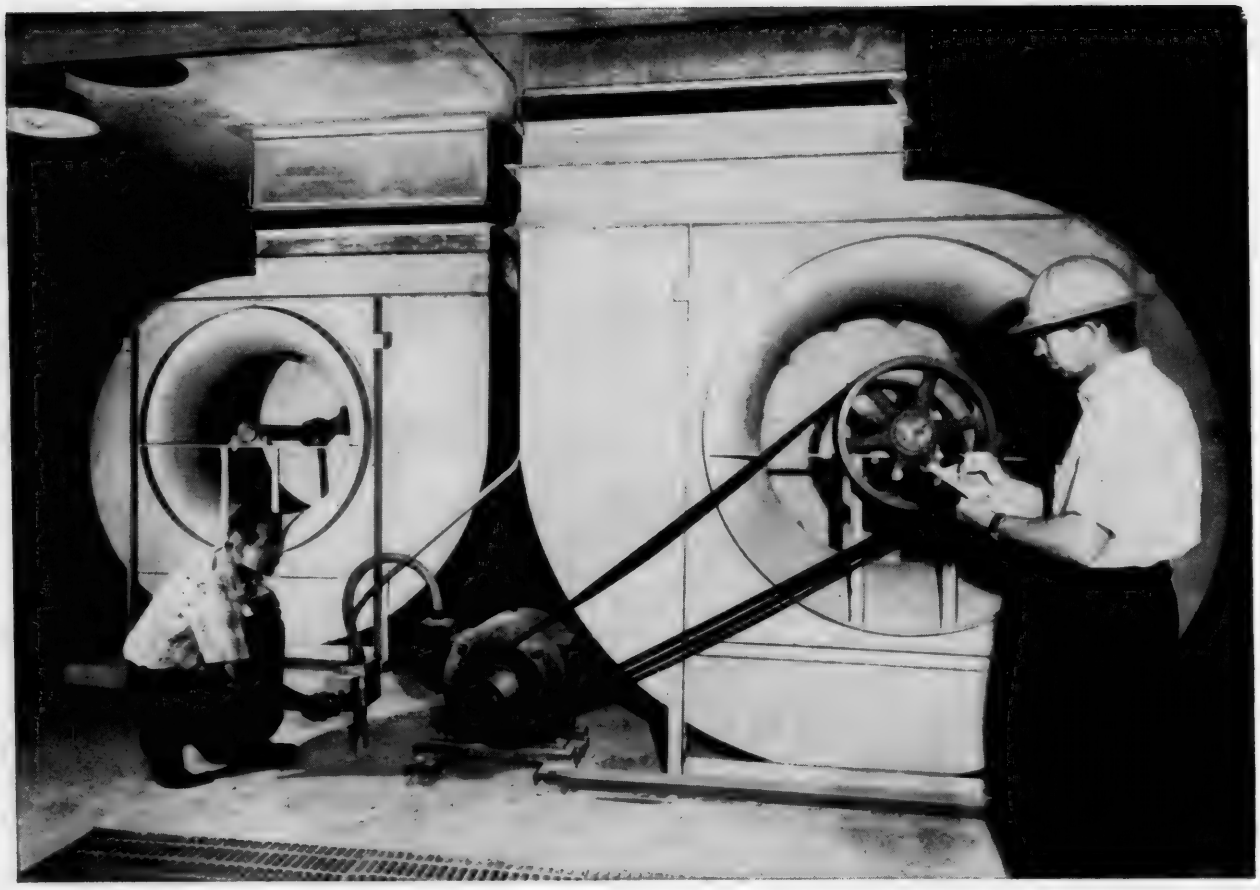

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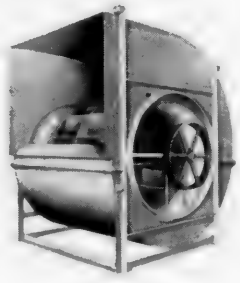

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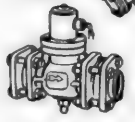
Solenoid Valves ...  ... *Thermostatic Expansion Valves* ... *and Refrigerant Distributors* ...

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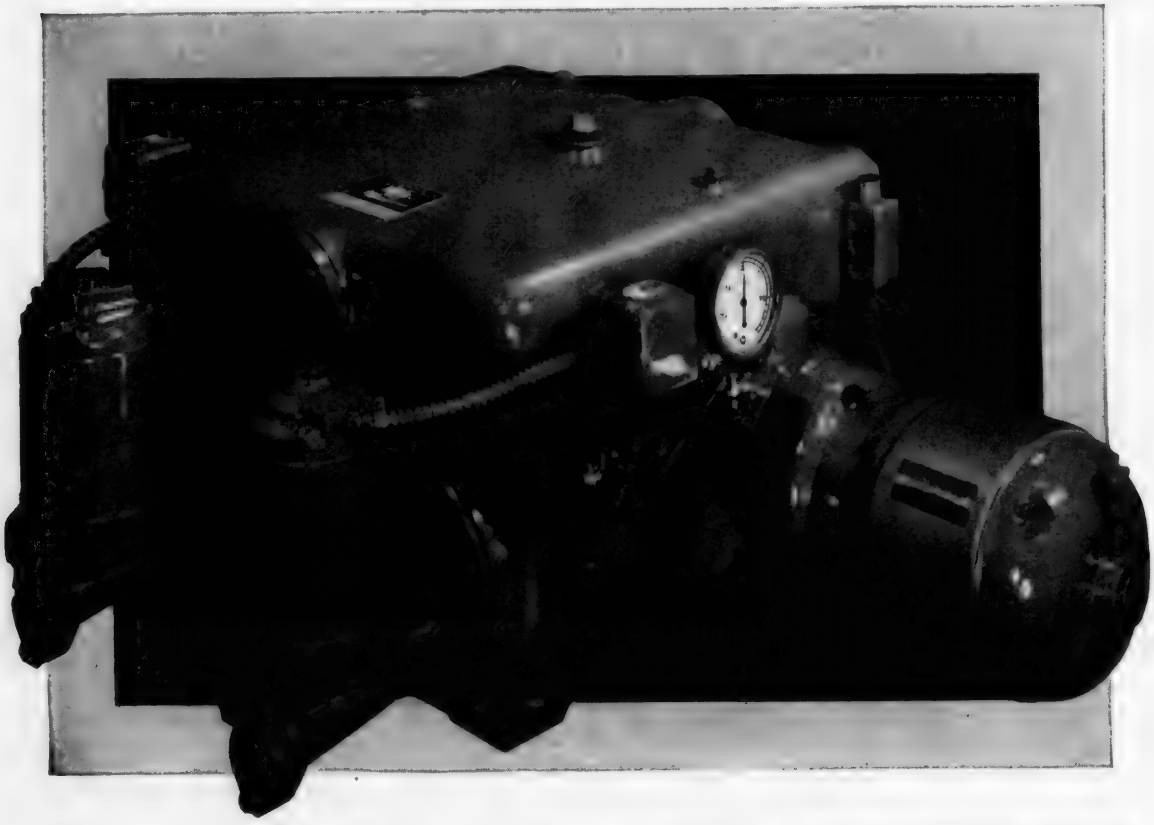

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American Electric Power Service Corporation
New York, N. Y.

Storing of heat developed from electric energy during night and other off-peak hours and drawing on this heat during periods of heavy heat requirements is a subject of interest to both the heating engineer and the electric utility companies. Such a method makes it possible to reduce the daytime electric demand and at the same time materially increase the annual load factor of the generating facilities, resulting in a lower electric heating cost to the customer. In some instances, it may enable the utility to offer an attractive off-peak energy rate. The author summarizes present methods actually in use.

THE GROWTH IN POPULARITY AND ACCEPTANCE of electric space heating,[1] during the past few years, has stimulated interest and activity in off-peak storage as a means of further improving its competitive position. Prior to this time, very little concerted effort has been made toward obtaining a practical and acceptable storage unit. Actually, heat storage research and development has been pursued more vigorously in Great Britain and several western European countries than in this country. This condition has probably occurred because foreign countries have long offered incentives, in the form of lower off-heating rates.

There are a number of widely different heat storage materials and methods being used or contemplated for the immediate future. Storage methods are generally classified as either a latent heat or sensible heat process. In a latent heat process, the addition or extraction of heat actually causes a phase change, such as from solid to liquid and liquid to gas or vice-versa. The sensible heat process, in contrast, experiences a rise or fall in the temperature of the substance. Examples of sensible heat material include water (between the freezing and boiling points), crushed rock, iron ore, solid masonry, and other such high density material.

Latent Heat Storage

Chemical storage, which falls within the latent heat classification, has been receiving some attention during the past years because of its attractive possibilities for storing large quantities of heat per unit volume. The potential offered by such a storage media is indicated in Table 1.

Recent explorations indicate that fused sodium hydroxide and calcium oxide hydration show some promise,[2] but considerably more investigation and development are required before an acceptable and practical chemical storage material can be expected.

Electric utilities, in cooperation with their trade association committees, plan to continue the research and development of this exceedingly attractive heat storage method and it is hoped that the chemical manufacturers and research organizations will actively cooperate in this project.

Sensible Heat Water Storage

Up to the present, water has probably been used more extensively than all of the other storage materials. When the large space requirements of the

[1] "Design and Application for Electric Heat," Sporn and Ambrose, Air Conditioning, Heating and Ventilating, July, 1960.
[2] "First Step of Heat Storage Research Program Completed," Edison Electric Institute Bulletin, p. 250, June, 1959.

TABLE 1—HEAT STORAGE CAPACITY OF VARIOUS MATERIALS

Media	Heat Storage Btu Per Cu Ft	
	Tank Un-Insulated	Tank Insulated
Unpressurized water	5730	3900
Unpressurized sodium hydroxide (boiling point raiser)	13500	7930
Fused sodium hydroxide	40600	30600
Calcium oxide hydration	97000	84000

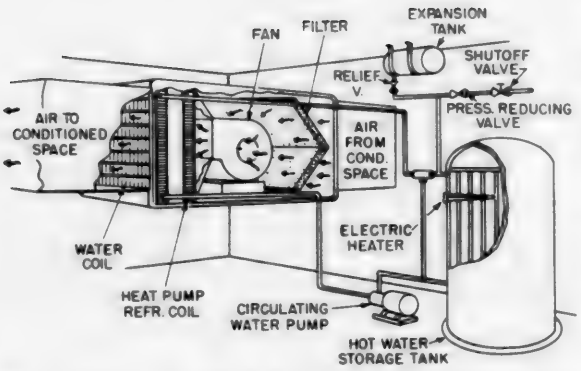


Fig. 1. Direct electrically-heated off-peak storage tank used as a supplement to a heat pump system.

storage tank can be accommodated in a practical manner, water will undoubtedly continue to be used for some time, particularly on the smaller installations, because of the lower first cost. The practical limit of unpressurized water storage systems will probably be in the neighborhood of 0.4 million Btu with a volume of no less than 110 cu ft. This practical limitation may be increased to 1 million Btu and a minimum volume of 125 cu ft, if and when acceptable water "boiling point raisers" are discovered or developed to maintain a high temperature without the accompanying higher pressure.[3]

One of several ways of adding storage to an electric heating system is illustrated in Fig. 1. This type of application can be used either with heat pumps or direct electric heating systems. When combined with a heat pump, the storage material can be heated to about 250 deg F with direct electric elements during the night or other off-peak periods. In this way during the day, the heat pump, supplying the base load, would be supplemented by the stored heat to obtain the most acceptable coincident demand and load factor. The same procedure could be followed with a direct electric heating system. In this case, the storage tank medium could be charged with a sufficient quantity of heat, during the off-peak periods, to supply up to 100% of the daytime requirements.

[3] "Analysis of Heat Storage Requirements and Proposal for Development of a Practical Heat Storage System for Joint AEIC-EEI Heat Pump Committee," July 14 and May 16, 1960. Comstock & Westcott, Inc., Cambridge, Mass. (Unpublished).

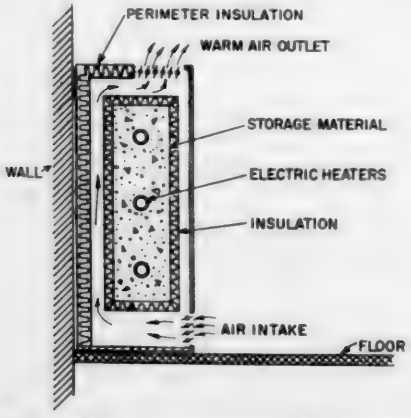


Fig. 2. Sectional view of a concrete block type of space heating unit for off-peak storage.

Sensible Heat High Density Storage

Electric heating units, employing storage material having higher densities than water, are readily available in many foreign countries. This storage material has the advantage of a wide temperature range to provide a considerably increased storage capacity per unit volume over that obtained with water.

Concrete block types of space heating units, as illustrated in Fig. 2, have been extensively promoted in Great Britain, Australia, and several European countries. These units are designed for individual room application, as contrasted with the central plant type of system generally used with water storage. Direct electric heating elements raise the temperature of storage material to about 400-600 deg during the off peak periods. This stored heat, in turn, is released to the room, usually by means of automatically operated dampers under control of a room thermostat.

It is suspected that the stand-by losses of these heaters are difficult to regulate and would tend to overheat the room during relatively mild weather conditions, when little or no heat is required. This overheating would not only cause uncomfortably high ambient temperatures but would materially decrease the overall efficiency of the system.

Crushed rock, through which air is allowed to pass, is another example of high density storage which has been used to a limited extent in different sections of the country. This method of storage has found some favor in connection with solar heating but does not seem to be too attractive for electric heating.

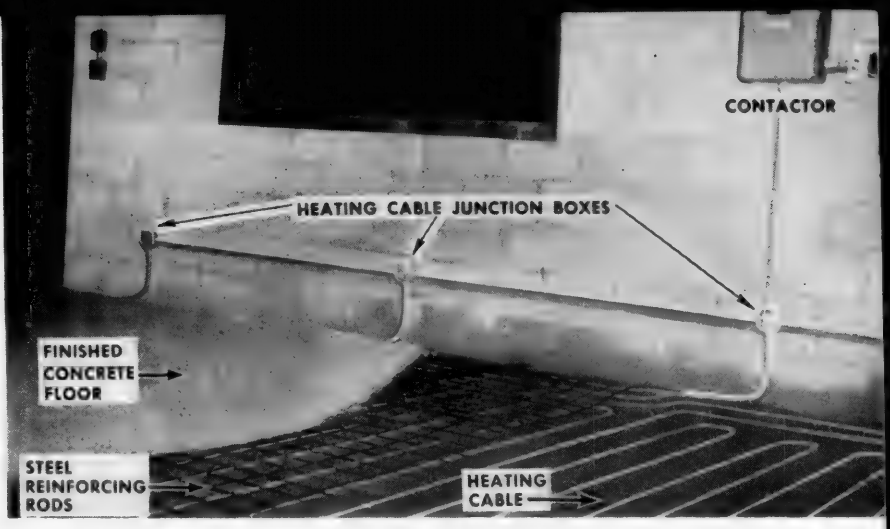
Low Temperature Floor Storage

Another type of high density storage which seems exceedingly attractive for electric heating is the low temperature concrete floor storage system.

Electric heating cable or bare metal rods can be used as electric conductors to heat the concrete. The electric heating cable can be either embedded directly in the concrete or enclosed in a specially developed housing section which, in turn, is buried in the floor.

The directly embedded cable is equipped with a jacket which is chemically unaffected by normal building material and has the advantage of low first cost and ease of installation. The heating cable, enclosed in a housing, on the other hand, will always be accessible for repair or replacement.

Experience has shown that this type of low temperature floor system will operate successfully either continuously or intermittently. In an intermittent system, it has been demonstrated that sufficient heat can be stored in the concrete slab, during predetermined off-peak periods, to maintain comfort conditions up to twelve hours each day. This fact is of particular interest to the electric utilities, because it offers a practical combination of electric heat and storage.



Figs. 3 and 4. Low temperature electric floor heating system in Ohio Power Co. service building, Portsmouth, Ohio. At right, first pour is completed, reinforcing steel and heating wire are in place for second pour. Below, concrete floor section shows location of heating cable, perimeter insulation and vapor barrier.

TABLE 2 — DATA ON ELECTRIC FLOOR HEATING SYSTEM, GENERAL STOREROOM AREA, PORTSMOUTH SERVICE BUILDING, OHIO POWER CO.

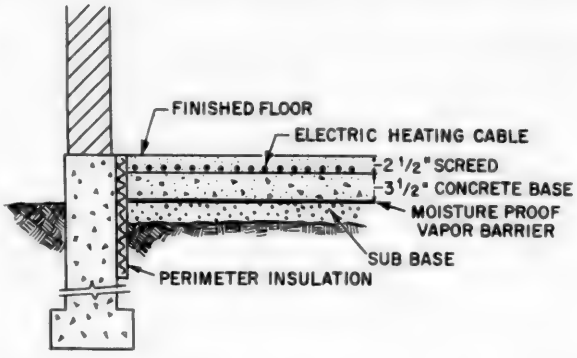
Design Temperatures		
Outside, 0 deg F		Inside, 65 deg F
Itemized Heat Loss		
Item	Btu per Hr	Kw
9087 sq ft ceiling	88,000	25.8
306 sq ft windows and doors	22,450	6.6
1324 sq ft exterior walls	35,800	10.5
364 cfm infiltration	25,550	7.5
Subtotal	171,800	50.4
133 ft exposed perimeter, floor	8,380	2.5
Total	180,180	52.9
Installed Heating Capacity		
2.7 watts per linear foot heating cable	41.6 kw	
Fan type unit heaters	20.0	
Total capacity	61.6 kw	
Radiant Floor Heating System		
Number of heating cables	13	
Length of each cable, ft	1193	
Watts, each cable, at 240 volts	3200	
Cable spacing, inches	7¼	
Watts per square foot floor area	4.58	
Number of room thermostats	2	

Notes

Power wiring for the 5 floor heating cables consists of one circuit 30 amps capacity, no. 10 conductor, serving 1 cable, 3200 watts capacity and 4 circuits, each 60 amps capacity, no. 8 conductors, each serving 3 cables, 9600 watts capacity each circuit.
All areas are based on interior dimensions. Floor heat loss based on exposed perimeter and 75 deg temp. difference. Infiltration approximately 1/5 air change per hour.

Such floor heating systems are rather extensive in Great Britain, but have only been used to a limited extent in this country.[4] It appears, however, that off-peak storage systems of this type are destined for wider public acceptance, particularly for warehouses, storerooms, garages, airline terminals, and

[4] "Electrical Floor Warming", Moule, Heating and Air Treatment Engineer, August, 1954.



other such commercial and industrial applications where warm floors are advantageous and where the inherent operating characteristics are acceptable. Several installations have been made in the United States, on a more or less experimental basis, in order to obtain the needed operating and design data.

One such experimental heating cable installation has been undergoing field observation and tests for the past couple of years in the Portsmouth Service Building of Ohio Power Company. This building is 215 ft long x 108 ft wide and two-stories high. The top floor, which is office space, is air conditioned year-round by a heat pump. The first floor, with 22,000 sq ft, is divided into a garage, general storeroom, meter storage and truck storage, and is heated by a 224-kw embedded cable system. The installation is illustrated in Fig. 3 and 4. Complete and detailed data, however, were continuously recorded only for the 9087 sq ft general storeroom. Some of these data, along with results and conclusions, are shown in Table 2 and Fig. 5.

Figure 3 shows the heating cable, the steel reinforcing rods and the method of connecting the power wiring to the cables, and Fig. 4 illustrates the method of applying the screed or the finished coat of concrete. This installation has a 6-inch concrete floor. After applying the perimeter thermal insulation, the concrete base was poured over the sub-base of gravel, sand, or other suitable granular material which was previously covered with a suitable vapor barrier. The heating cable was carefully spaced on top of the concrete base, followed by the reinforcing roads and the screed.

Table 2 itemizes important design data, including

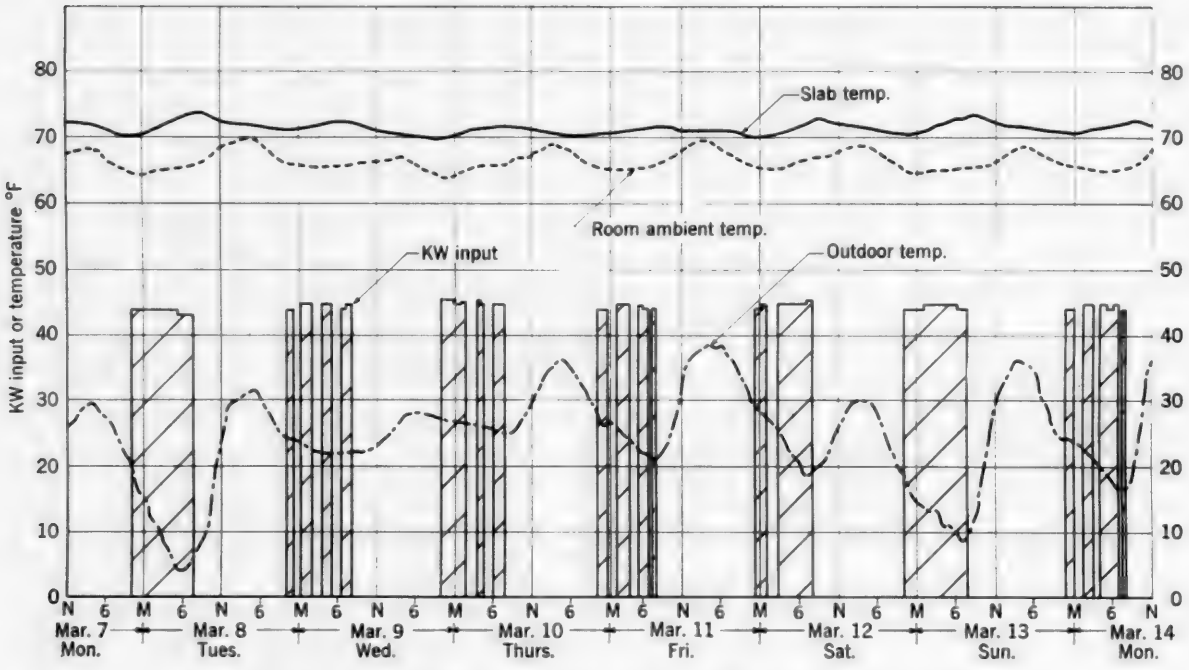


Fig. 5. Time versus electric input, slab and air temperatures, with controlled slab temperature, for the Portsmouth service building.

calculated heat loss and size, type and amount of heating cable. The 20 kw of unit heaters, listed under Installed Heating Capacity (Table 2), were installed as a stand-by in case the floor system proved unacceptable. The embedded heating cable, however, has had adequate capacity and it has been unnecessary to use the unit heaters.

The demand in kilowatts and the kilowatt-hour consumption were continuously recorded along with the indoor, outdoor and floor slab temperatures, as illustrated by Fig. 5. Note that the slab heating was confined to the hours of 10 pm to 8 am. Also, during the remaining non-charging hours, the room ambient temperature held between 65 and 70 deg F, even though the outdoor temperature varied from a high of 38 to a low of 5 deg. The increases in ambient temperature, during the day when the slab was not being heated, are probably due to the 12 kw of lighting, together with the solar effect and various internal heat gains due to occupancy.

Fig. 6. Method of connecting power cable to wire reinforcing-heating cable for Northern State Power Co. installation. Photo, courtesy Electrical Construction and Maintenance magazine.

Installations Using Reinforcing Steel Rods

Bare metal wire or rods, instead of heating cable, to conduct the electric current have been used on several occasions in this country. Such an installation has attractive first cost possibilities because the embedded rods serve both as a heating system and as a substitute for the normally installed reinforcing steel for the concrete.

In such an installation, for the larger building it is best to divide the floor into a number of areas of 1000 to 1200 sq ft. A grid assembly is prefabricated and installed in each of the floor areas, as shown in Fig. 6. An approximately 12½-kva transformer is connected to each grid assembly. Electric power at 240 or 480 volts can be supplied through a suitable circuit breaker to the primary side of the transformer where it is stepped down to about 30 to 55 volts to feed the metal grid. By varying the transformer secondary voltage, the output of the floor grids can be regulated to provide heat in the exact quantities required.

One installation, employing commercially available expanded metal reinforcing grids, was made in 1957 for a 92000 sq ft warehouse in Chicago.[5] The electrical demand consists of 770 kw of heating, 159 kw

of lighting, and 115 kw for snow melting of the outdoor loading ramps. The floor heating capacity averages 8.35 watts per sq ft.

At least one manufacturer has a pre-engineered grid assembly available to cover 30 ft x 40 ft floor area, as illustrated in Fig. 7 and 8. Several installations of this design have been made and are operating very satisfactorily. Indications are that the complete installation cost, including cost of transformer, power wiring and grids will be in the neighborhood of 65 cents per square foot.

Recommended Design Procedures

For efficient operation, it is essential that each installation be correctly designed and installed in accordance with manufacturer's instructions and recommendations. There also must be close cooperation between the building contractor and the electrical contractor.

In many installations it may be necessary to zone the heating according to the orientation and/or the use and occupancy of the space. In some instances, it may be desirable to have a higher indoor temperature than the 65-70 deg generally obtained from a floor slab temperature of 70-77 deg. In this case, it probably would be more desirable to use the floor system to carry the base load, and supplemental electric heaters in the form of baseboard convectors, unit heaters or infrared units to provide the peak heating.

The total heat emission from a low temperature floor system can be found by calculating the rate of radiation heat emission from a hot surface in stated surroundings, together with the rate of convection heat loss[6] to the ambient air. Where temperatures are comparatively low and the differences small, the formulas for the two types of emission can be combined and simplified, as indicated below, with a probable error of less than 7%.

$$H_R = h_r\,(t_s - t_r)$$
$$H_C = 0.32\,(t_s - t_a)^{1.31}$$
$$H_T = H_R + H_C$$

H_R = Radiation heat emission from surface per sq ft
H_C = Convection heat emission from surface per sq ft
H_T = Total heat emission from surface per sq ft
t_s = Temperature of floor surface, deg F,
t_a = Temperature of indoor ambient, deg F,
t_r = Mean surface temperature of surroundings, deg F,
h_r = Coefficient of radiant heat transmission, Btu per (sq ft) (deg F temperature difference, $t_s - t_r$)

It can be generally assumed that $t_r = t_a$ so that a value for H_T can be calculated by the above formulas. Many experimental results indicate that the total heat emission will be close to 1.7 Btu per (sq ft) (deg temperature difference between floor surface and air) for a floor of 75 deg, air and surrounding surface of 65 deg, and with ventilation of about one-half

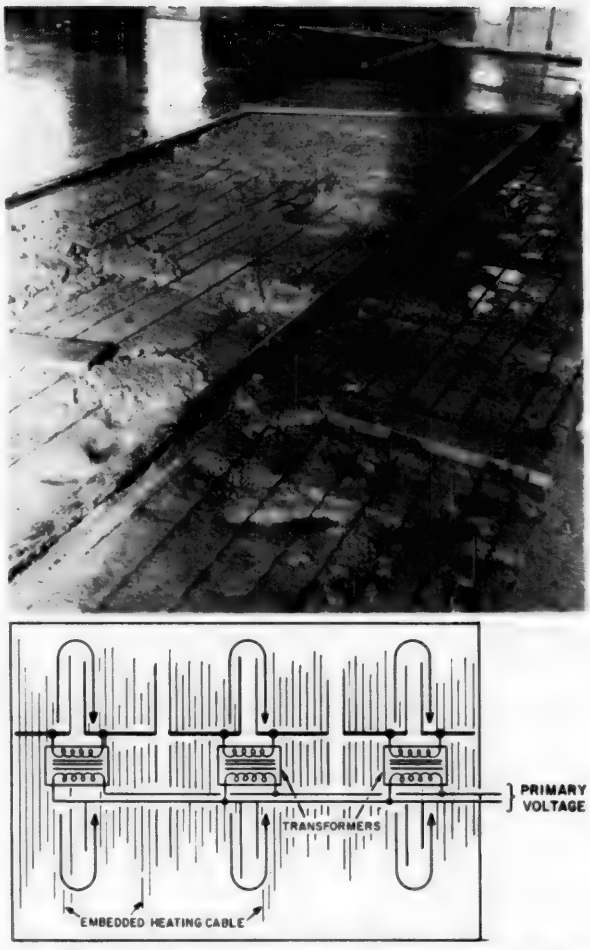


Fig. 7 and 8. Pre-engineered grid assembly, embedded in concrete slab, is used for electric floor heating. Photo, courtesy Williams Form Engineering Corp., Grand Rapids, Mich. Plan, below, shows power wiring for this type of installation.

air change per hour. Higher infiltration and ventilation rates increase the convection emission from the floor surface. For optimum comfort, the floor temperature should not exceed 77 deg.

Edge insulation is recommended for all electrically heated floor systems. It should be continued under the concrete base or downward for a distance of 12 to 18 inches. Normally, the downward heat flow is insignificant and need not be considered. Insulation beneath the surface, however, may be justified if the concrete slab is on high thermal conductivity soil, such as wet clay.

The installed heating capacity should be calculated in the conventional manner. This capacity should exceed the total continuous rate of heat transmission from the floor (both upward and downward) over a 24-hour period. Usually, about 30% excess capacity will be satisfactory if the input of energy to the floor takes place at off-peak times only. But this excess will depend to a considerable extent upon the operating cycle, amount of useful internal heat gain, assumed ventilation or infiltration rate, and safety factors included in the heat loss calculations.

[5] "Off-Peak Kilowatts Heat Warehouse via Floor Reinforcing Steel," Jonelis and Geyer, Electric Light and Power, May 1, 1957.
[6] The formula for heat loss by convection is from the ASHRAE Guide, 1960, Chapter 30.

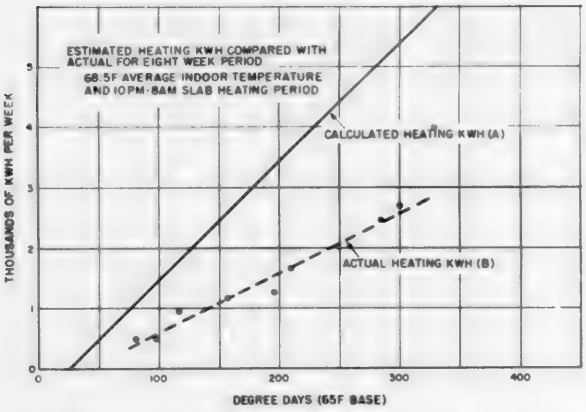

ESTIMATED HEATING KWH COMPARED WITH ACTUAL FOR EIGHT WEEK PERIOD
68.5F AVERAGE INDOOR TEMPERATURE AND 10PM-8AM SLAB HEATING PERIOD
CALCULATED HEATING KWH (A)
ACTUAL HEATING KWH (B)
THOUSANDS OF KWH PER WEEK
DEGREE DAYS (65F BASE)

Fig. 9. Calculated load as compared with actual load, Portsmouth service building.

The installed heating capacity of the Portsmouth Service Building, for instance, is only 4.6 watts per square foot, but for other installations 15 watts per square foot or even higher may be justified, providing the surface temperature limitation is not exceeded. Similarly, the heating capacity of the cable or wire may also vary. Heating capacity of cable ranges from 2 to 7 watts per linear foot with the average around 3.75 watts per linear foot, while that for bare wire is as high as 6 to 12 watts per linear foot.

The energy consumption estimates, of course, should be based on the heat requirements rather than the installed capacity. The normally used conventional fuel estimating formula, when applied to this type of electric heat, will usually yield an excessive value unless the proper correcting factor is introduced. An indication that, under certain conditions, the actual energy consumption will be about 50% of the calculated value when using the conventional fuel estimating formula is shown in Fig. 9.

There are undoubtedly a number of reasons for this discrepancy. One contributing factor, frequently mentioned, is the lower floor-to-ceiling temperature gradient obtained with floor heating. A study made in Great Britain indicates that a floor system, in comparison with a convection system, will maintain a 7 to 8 deg lower air temperature at the ceiling, as indicated in Fig. 10.[4] If this is true, then the heat loss through the roof will be lower with a corresponding reduction in energy consumption. In all probability, the main reason for the lower kilowatt-hour consumption due to the safety factors normally used in the heat loss calculations, but further field test data are needed before definite conclusions can be made.

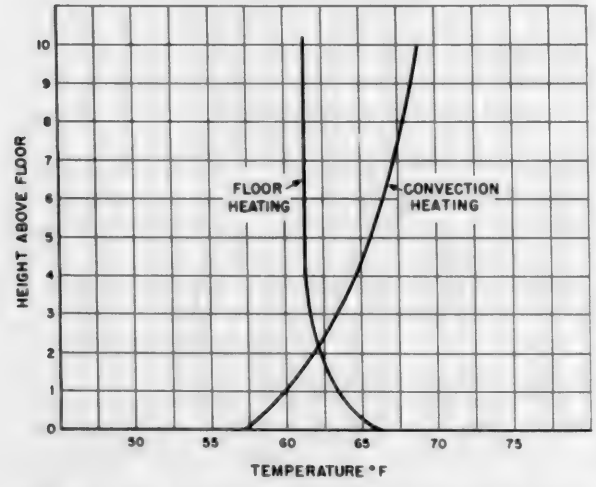


Fig. 10. Typical probable temperature gradients of floor and convection heating systems. Illustration, courtesy Heating and Air Treatment Engineer.

The type of control employed to regulate the heating system can materially influence the satisfaction and economy of operation. A time switch must be used with an off-peak installation to make certain that the energy will be supplied to the slab during the specified periods. Normally, it is also advisable to provide an in-the-floor type of thermostat to prevent excessive air temperatures. Other controls may be necessary or desirable, depending on the type and occupancy of the space.

Some installations have employed an outdoor compensator type of control. The idea is to readjust the floor temperature downward as the outdoor temperature increases. The outdoor element should be influenced by the wind and solar effect, as well as by the dry bulb temperature. This type of control may be difficult to justify, because the floor has considerable mass which changes temperature very slowly and, consequently, the effect of these various external elements are difficult to predict or evaluate twelve hours or more in advance.

Future Progress

The acceptance of heat storage will be influenced to a considerable extent by the practical and desirable aspects of the system, when compared with other available means of comfort heating. In the final analysis, the owning and operating cost of this type of application must be attractive and acceptable to the purchaser and user.

Several domestic tank manufacturers and hydronic suppliers of heating equipment are showing increasing interest in high temperature water storage units, and a number of trial installations are being made in several geographic areas. Also, research was recently initiated to find a practical way of employing chemicals to materially increase the quantity of heat per unit volume and thereby reduce space requirements and increase the attractiveness of this type of system. In addition, the electric utilities are keenly interested because of the inherent possibilities offered by heat storage to permit regulating the time of occurrence and the size of the coincident electric heating demand, and thus mutually benefit the company and the customer.

All of these influencing activities and developments are most encouraging, and certainly an increase in the number of installations and accelerated efforts to improve the acceptance of this type of system can be expected in the immediate future.

Electronic Air Cleaners and their Application

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Electronic air cleaners can be installed alone; they can be used with different types of prefilters; and they can be incorporated into cost-saving "air-recovery systems". This article discusses electronic air cleaners and these various applications. Included are installation and maintenance techniques, and a look at typical installations.

THE ELECTRONIC AIR CLEANER should be selected for the particular job. Generally, a cleaning efficiency of 90% with air moving at 500 fpm is the accepted standard. (Efficiencies are based on National Bureau of Standard's dust spot test method.) In a given installation higher efficiencies can be had by reducing the air velocity moving through the electronic air cleaner. Cleaners with collector plates closer togther will have higher efficiencies, although at the expense of more frequent maintenance. These cleaners may also require more prefiltration equipment for satisfactory operation. The washing equipment supplied with the cleaner also contributes to the system efficiency; for example, a moving manifold provides better washing than a stationary manifold.

Prefiltration

An electronic air cleaner will work more satisfactorily if a prefilter is used to prevent large dirt particles getting into the cleaner. The degree of prefiltration depends on how dirty the incoming air is and what cleaning efficiency is necessary. With outdoor air, prefiltration is virtually a most. But the prefilter should be located so it handles both outside and return air.

The first prefilter should be a very coarse screen (mesh approximately a half-inch square) installed in all outdoor air intakes to prevent birds and very large particles from entering the air-handling system. Such a coarse screen is not sufficient, however, to sieve out large particles which may make the electronic air cleaner arc excessively and actually short out. Therefore, secondary prefiltration is required. Insect screen (14 to 18 mesh) may be used, but this requires periodic cleaning to avoid excessive pressure drop. If insect screen is used, it should be installed where it can be easily maintained.

A better type of prefiltration is a standard mechanical air filter such as spun glass, expanded aluminum or the various plastic fiber filters. These also require periodic maintenance to avoid excessive pressure drops.

The best prefilter for an electronic air cleaner is a traveling curtain fibrous mat adhesive-impregnated prefilter. Such a unit takes out most of the large dirt particles. In addition, these units are equipped with an advance mechanism to avoid excessive pressure drops and periodic attention. The most troublefree electronic air cleaner installations are installed behind such a prefilter.

Whatever prefilter is used, it should be located in the system where it encourages periodic maintenance. Also, any prefilter adds a certain pressure drop to the system and this should be considered during the design stages of the installation.

Air Flow

As mentioned before, an electronic air cleaner is sensitive to air velocity through its cells. Efficiency ratings are established with an even air flow across the entire face area of the cleaner. Therefore, the air entering the electronic air cleaner must be evenly distributed across its face to obtain specified efficiencies. This requires well-designed ductwork, with turning vanes or baffles where necessary. There should be no sharp turns or transitions in the ductwork immediately upstream from the air cleaner. Face and bypass dampers or any other obstructions which might cause an uneven air flow across the cleaner should also be avoided.

If prefilters are installed immediately upstream from the air cleaner, they will act as effective air baffles and help even out air flow across the cleaner.

It should be remembered that air passing through an electronic air cleaner at high velocity will not be compensated for by remaining air going through at a lower velocity. The ability of the air cleaner to remove dirt decreases rapidly as the air velocity increases. However, efficiency of an electronic air cleaner increases less rapidly as the air velocity is slowed down.

Location in the System

An electronic air cleaner should be located in the mixed air plenum to filter both return and outdoor air.

If, however, the electronic air cleaner must handle outdoor air at below-freezing temperatures, it will be necessary to provide warmer air to dry the air cleaner during the wash cycle. This can be done by dampers shunting return air through the electronic air cleaner, by circulating equipment room air through the unit, or by preheaters. Electric preheaters have been used successfully for this.

Sub-zero temperatures have also caused problems with broken ionizing wires. Preheaters for warming the extremely cold air have proved very effective in reducing ionizing wire breakage and, therefore, downtime and maintenance costs.

Stratification of return air and very cold outside air as they enter an electronic air cleaner can mean severe ionizing wire breakage in the sections getting the blast of unmixed outdoor air, while the sections handling the warmer return air will have little or no wire breakage. Therefore severe stratification of outdoor and return air should be avoided.

Humidity

Electronic air cleaners will work at very high humidities so long as the moisture doesn't condense in the air cleaner. Therefore an electronic air cleaner should never be installed downstream of an air washer or humidifying equipment unless very effective water-elimination is installed. If an electronic air cleaner is installed close to an outdoor air intake, provisions should be made to eliminate rain and snow. Very dense fog can create arcing problems; the best solution is preheaters. In less severe areas, prefiltration equipment may eliminate the moisture problem.

Incidentally, an electronic air cleaner in good operating condition will be much less susceptible to condensation or high humidity conditions than one in marginal operating condition or extremely dirty. The dirt absorbs the moisture and creates oversurface arcing on insulators.

If the air cleaner is installed in an area with high humidity conditions, drying time after a wash cycle will probably be excessive.

Noise

The electronic air cleaner normally has a slight sizzle or hiss, heard only within a very short distance. Arcing, however, can be a serious problem if the electronic air cleaner is installed in areas where any noise is objectionable, such as a hospital. The arcing "snap" can travel a long distance through the ductwork.

A minimum amount of arcing (perhaps an arc every 5 minutes) should be expected on systems that are not well prefiltered. If this is objectionable, adequate prefiltration will eliminate it.

Washing

The wash cycle can be automatic so that an operator is not required in attendance during the wash cycle, or it can be semi-automatic. The automatic cycle can be started by a clock device or a man pushing the wash button. This attention is desirable, for it means periodic inspection of the cleaner for proper operation, water supply, adhesive, satisfactory drainage and to make certain all ionizing wires are in place. Once the inspection has been made and the washing cycle started, the electronic air cleaner will wash itself, turn on the fan to dry itself, shut down the fan to apply an adhesive (if used), provide a drip period for the adhesive, then bring itself back on the line—all automatically.

With a semi-automatic system, the operator starts and stops the cycle, applies adhesive and turns the unit back on the line. The semi-automatic wash control permits flexibility not possible with the automatic cycle. In high humidity conditions, for example, it may be necessary for the air cleaner to dry longer than the time normally provided in the automatic wash cycles.

For best cleaning results hot water should be used for washing the units. Hot water cuts the greasy material collected by an electronic air cleaner much more effectively than cold water. It also has the advantage of accelerating the air cleaner drying time after a wash cycle.

Some cold-water adhesives can be used where hot water is not available. However, washing an electronic air cleaner is one of the major items of maintenance and the benefits of hot water will more than repay its cost.

A fast drain is essential to remove the dirty water quickly, so the water doesn't evaporate during the drying period of the wash cycle. This will also help eliminate depositing dirt in the drain basin. The drain should be trapped so sewer gases or uncleaned air cannot enter the ductwork between wash cycles. It should be remembered that water traps may dry out between wash cycles and not provide the air seal necessary.

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TYPICAL AIR-RECOVERY APPLICATIONS

Problems

Bowling alleys have general and specific air problems. General: Outside dirt is carried in by shoes, clothes, and air conditioning system; tobacco smoke is extremely heavy. Specific: Sanding lanes generates fine sawdust which can ruin gears and cams of automatic pin-setting machinery; bowling balls stir up wax and sawdust.

Results

Installed system removes virtually all dirt, dust, lane wax, lint, smoke and wood particles. Visibility is better; air smells fresh and clean. Redecorating is not necessary, only done to change color schemes. Bowlers note and appreciate cleanliness.

Taverns have smoke problems which are compounded by liquor odors. Low ceilings, heavy crowds add to stuffy, irritating conditions. Exhaust fans in application pictured were not satisfactory, and pulled out cool air in summer, warm air in winter.

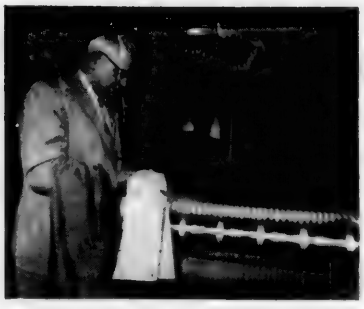
Air stays clear, fresh at all times. Heating and cooling costs have been cut by recirculating interior air through electronic air cleaner, activated charcoal filter.

Clouds of choking dust are stirred up by giant mixers blending powdered abrasives and bonding resins at this grinding wheel plant. Besides creating health problem, dust covered everything, including air conditioner coils, with sticky, glue-like coating.

Air conditioning equipment and operating costs, as well as maintenance costs, have been cut; motor bearing life has been extended. Machines do not need individual dust collectors.

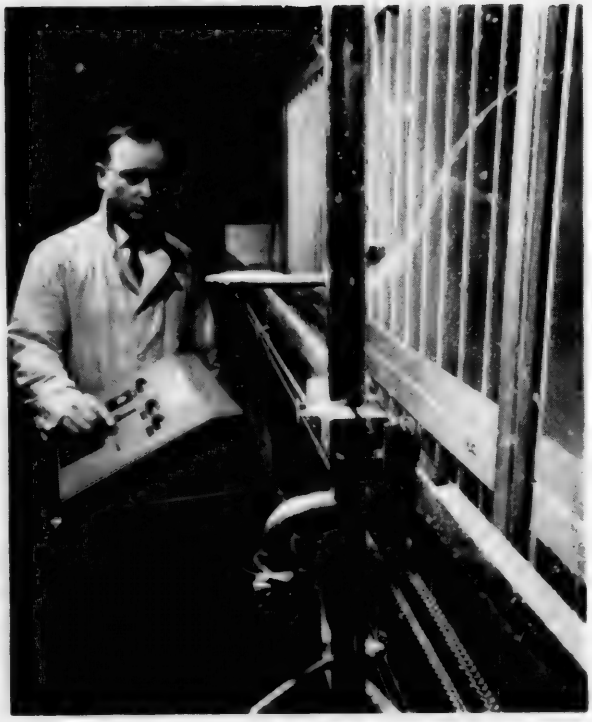
Grills in bowling alleys can be a troublesome source of smoke, grease and odors. Exhaust fans can remove a portion of this, but also remove costly conditioned air.

With an air-recovery system, air in grill area of bowling alley is reported to stay fresh and clean, even on nights when attendance reaches peak capacity.



Located in an industrial area only a few miles from Pennsylvania's anthracite coal country, this textile mill was plagued with dirt getting on finished goods. Whites were grey; colors varied from one bolt to the next. Loom maintenance was costly.

Woven goods reject rate has been slashed by 30%; loom-finished whites are much cleaner. Humidity control has been aided; atomizing nozzles don't get clogged. General maintenance has been reduced.



A traveling water spray manifold with a flutter jet provides speed and efficiency in cleaning collector plates on electronic air cleaner. Operator, author of this article, pushes a button to start the "flip-flop" cleaning.

Electricity

Power for the electronic air cleaner should be from a dependable non-fluctuating source. Any fluctuations in the primary circuit of an electronic air cleaner are multiplied many times in the secondary. These fluctuations may be severe enough to adversely affect its efficiency.

The electronic air cleaner should be connected to the load side of the fan starter so that the air cleaner will never be on when the fan is not operating.

Ozone generated by an air cleaner is no problem when air is moving through at the manufacturer's specified rate. However, when an electronic air cleaner is operated without air moving through it, the ozone concentration can build up and may be noticeable downstream momentarily when fans are restarted.

Air-Recovery Systems

A single cubic foot of outside air can hold up to 100 million dirt particles, ranging from "large" ones barely visible to the unaided eye down to small ones .01 micron long.

Getting these particles out of the air is a problem. An ordinary blanket-type air filter (when clean) can strain out dirt particles 5 microns and larger. But it cannot remove the smaller ones, which account for 90% of the dirt stains in a building.

Once inside a building, dirt costs money. Cost studies show that office building owners and managers spend an average of 54 cents a square foot annually just to keep buildings clean. This 54 cents is the largest single maintenance expense, amounting to one-fourth of the entire operating cost of an average office building.

To reduce airborne dirt in a building, many engineers have turned to air-recovery systems. Not only does an air-recovery system remove nearly all dirt particles from the air, but it also reduces the outside makeup air requirements and, therefore, the amount of new dirt brought into the building. (Most airborne dirt comes into a building through the air-conditioning system.)

An air-recovery system usually consists of an electronic air cleaner (or precipitator) teamed with an activated-charcoal filter. The electronic air cleaner electrically removes up to 95% of dirt particles .01 micron and larger. The activated charcoal takes out odor molecules, leaving the air smelling fresh and clean.

In this type of system, the electronic air cleaner and the activated-charcoal filter are considered as a unit. Without the electronic air cleaner the extremely tiny passages in the charcoal would soon be clogged with dirt, rendering it useless. Without the charcoal, the air cleaner would sieve out dirt particles, but would not remove odor and gas molecules; therefore, vast quantities of outside air would have to be brought in as a diluent.

It is by removing dirt and odor and thereby reducing the outside air requirements that an air-recovery system makes possible substantial savings over a conventional air-conditioning system in heating and cooling costs.

Activated-charcoal Filter

During the first few months' operation of an air-recovery system, a sample of the activated charcoal in the filter will be tested by the manufacturer to determine its approximate life. As the time approaches when it should be renewed, replacement reactivated charcoal should be ordered from the manufacturer. After the used charcoal has been removed, it is returned to the manufacturer for reactivation.

While it is difficult to predict the life expectancy of activated charcoal, generally it should last from 12 to 18 months.

Maintenance, then, on an air-recovery system is simple and low in cost. Pushing a button every few weeks to wash the electronic air cleaner and replacing the activated charcoal every year or so are the major points.

Operating costs of an air-recovery system are comparable to a conventional filter system. Savings on air-conditioning operating costs, however, mean substantial advantages every year in favor of the air-recovery system. Add to this the other benefits—a cleaner atmosphere for improved production, improved quality control, improved employee morale, more attractive surroundings, reduced building maintenance—and an air-recovery system has demonstrable benefits for nearly every commercial system.

ESTIMATING

Job Time Reference Data

Part 4 in this series on estimating continues the publication, begun last month, of a group of tables containing specific estimating data in terms of man-hours of labor. Instructions for proper application of these tables are outlined in the accompanying text.

ROBERT J. SMITH
Estimator
Sanderson & Porter, Inc.
New York, N. Y.

WHEN SANITARY SOIL, WASTE AND VENT LINES or storm leaders and drains are installed, the use of cast iron soil pipe and fittings is involved. Sometimes wrought iron or steel pipe with screwed fittings are used in conjunction with the soil pipe.

The man-hours covering the installation of screwed pipe and fittings were shown in Table 4 (June ACHV).

Table 6 applies to the use of soil pipe and may be used for standard, extra heavy or service-weight pipe and fittings.

To use this table the estimator would apply the man-hours shown against the linear feet of pipe and the individual fittings and specialties listed in his take-off. The number of joints would then be counted in order to estimate the quantity of caulking lead and

TABLE 6—CAST IRON SOIL PIPE—INSTALLATION TIME

To Position or Perform	2"		3"		4"		5"		6"		8"		10"		12"	
	Minutes	Man-Hours	Minutes	Man-Hours	Minutes	Man-Hours	Minutes	Man-Hours	Minutes	Man-Hours	Minutes	Man-Hours	Minutes	Man-Hours	Minutes	Man-Hours
Lineal Foot—Pipe	12	.02	1.8	.03	2.4	.04	3.0	.05	3.6	.06	4.8	.08	6.0	.10	7.2	.12
Bends	60	1.00	78	1.30	102	1.70	114	1.90	138	2.30	162	2.70	210	3.50	258	4.30
Tees & Ys	78	1.30	108	1.80	150	2.50	168	2.80	198	3.30	228	3.80	306	5.10	384	6.40
Combination Y and 1/8 Bend	78	1.30	108	1.80	150	2.50	168	2.80	198	3.30	228	3.80	306	5.10	384	6.40
Cross or Double Y	96	1.60	138	2.30	198	3.30	222	3.70	258	4.30	294	4.90	402	6.70	498	8.30
Double Combination Y and 1/8 Bend	96	1.60	138	2.30	198	3.30	222	3.70	258	4.30	294	4.90	402	6.70	498	8.30
Tapped Tee or Cross	60	1.00	78	1.30	102	1.70	114	1.90	138	2.30	162	2.70				
Reducers			66	1.10	84	1.40	96	1.60	108	1.80	132	2.20	162	2.70	210	3.50
Plugs	24	.40	36	.60	48	.80	54	.90	60	1.00	72	1.20	96	1.60	120	2.00
Clean-out Ys	60	1.00	78	1.30	102	1.70	114	1.90	138	2.30						
Clean-out Plug	48	.80	60	1.00	72	1.20	84	1.40	96	1.60	120	2.00				
P-Trap	60	1.00	78	1.30	102	1.70	114	1.90	138	2.30	162	2.70	210	3.50	258	4.30
Floor Plate	90	1.50	120	2.00	168	2.80	180	3.00	192	3.20	210	3.50				
Floor Drain	180	3.00	240	4.00	330	5.50	360	6.00	384	6.40	420	7.00				
Roof Drain	150	2.50	210	3.50	300	5.00	330	5.50	360	6.00	390	6.50				
Vent Sleeve	150	2.50	210	3.50	300	5.00	330	5.50	360	6.00	390	6.50				
Hanger	90	1.50	120	2.00	120	2.00	120	2.00	120	2.00	150	2.50	150	2.50	150	2.50
Lead and Oakum Cauked Joint	24	.40	36	.60	48	.80	54	.90	60	1.00	72	1.20	96	1.60	120	2.00

TABLE 7—BELL AND SPIGOT PIPE AND FITTINGS—INSTALLATION TIME

Pipe Size	Lineal Foot—Pipe 150#	Lineal Foot—Pipe 250#	Bends	Tees	Reducing Tees	Cross	Reducing Cross	Reducer	Sleeve	Plug or Cap	Valve with Pos. Ind.	Fire Hydrant	Valve with Curb Box	Bridle & Clamp	Line Joint
	Time in Man-Hours to Position or Perform														
3"	.12	.13	3.18	4.5		6.1			2.8	1.3	7.3		5.3	2.0	1.2
4"	.16	.18	4.1	6.1	5.6	8.1	7.1	3.3	3.7	1.3	8.2		6.2	2.0	1.6
6"	.26	.30	6.2	9.2	8.2	12.2	10.2	5.0	5.5	2.4	10.7	10.4	8.7	2.0	2.4
8"	.36	.40	8.5	12.5	11.5	16.5	14.5	7.0	7.4	2.6	13.0		11.0	2.4	3.2
10"	.46	.50	10.8	16.0	13.9	20.9	16.9	8.1	9.2	3.0	16.3		14.3	2.4	4.0
12"	.60	.60	13.3	19.5	17.5	25.4	21.5	10.3	11.3	5.3	18.8		16.8	2.4	4.8
14"	.70	.70	14.6	21.6	18.7	28.8	22.7	10.6	12.1	5.6			19.4	2.8	5.6
16"	.80	.80	18.1	26.0	22.8	34.4	27.9	13.6	14.3	6.6			21.2	2.8	6.4
18"	.90	.90	20.7	29.7	25.7	39.0	30.9	14.6	15.8	7.6			24.6	2.8	7.2
20"	1.00	1.00	24.0	34.5	30.1	45.3	36.3	16.7	18.4	8.6			29.6	3.2	8.0
24"	1.20	1.20	31.9	45.7	37.2	61.1	43.7	23.2	22.5	12.9			36.8	3.2	9.6
30"	1.50		38.7	55.4	45.9	72.5	48.0	25.1	25.4	14.7			43.6	3.6	12.0
36"	1.80		56.0	74.7	60.6	95.6	63.4	33.0	31.8	18.8			72.8	4.0	14.4
42"	2.10		70.7	99.8	79.7	137.8	84.6	37.5	38.0	24.3			92.8	4.4	16.8
48"	2.40		91.7	138.8	84.6	177.5	100.2	65.6	44.7	29.8			106.8	4.8	19.2

TABLE 8—MECHANICAL JOINT PIPE AND FITTINGS—INSTALLATION TIME

Pipe Size	Lineal Foot—Pipe 150#	Lineal Foot—Pipe 250#	Bends	Tees	Reducing Tee	Cross	Reducing Cross	Reducer	Sleeve	Plug or Cap	Line Joint
	Time in Man-Hours to Position or Perform										
3"	.12	.13	2.3	3.5		4.7			2.2	1.1	1.0
4"	.16	.18	2.5	3.8	3.7	5.0	4.9	2.4	2.3	1.2	1.0
6"	.26	.30	3.8	5.8	5.2	7.6	6.4	3.1	3.5	1.8	1.5
8"	.36	.40	4.2	6.4	6.2	8.3	8.1	3.9	3.6	2.0	1.5
10"	.46	.50	5.6	9.1	8.0	11.8	9.8	4.7	4.8	2.7	2.0
12"	.60	.60	6.4	10.1	8.9	13.0	10.6	5.0	5.1	2.9	2.0
14"	.70	.70	8.1	13.2	11.5	17.0	14.2	6.7	6.7	4.0	2.5
16"	.80	.80	9.9	16.3	13.5	20.9	16.2	7.7	8.1	4.9	3.0
18"	.90	.90	10.8	18.2	14.2	23.2	17.0	8.4	8.4	5.4	3.0
20"	1.00	1.00	12.9	21.9	16.4	27.8	19.2	10.3	9.8	6.6	3.5
24"	1.20	1.20	16.7	29.5	20.6	37.0	24.2	13.0	11.6	8.2	4.0
30"	1.50		27.2	44.1	29.2	54.5	32.8	18.8	15.7	12.1	5.0
36"	1.80		37.4	60.4	40.6	73.5	42.9	25.3	19.8	16.8	6.0
42"	2.10		50.7	79.8	50.9	95.7	54.7	31.1	26.8	22.3	7.0
48"	2.40		66.2	101.6	64.1	119.9	70.0	46.5	31.2	28.8	8.0

REFERENCE DATA

TABLE 9—FLANGED PIPE AND FITTINGS—INSTALLATION TIME

To Position or Perform	1/4"	3/8"	1/2"	3/4	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
	Time in Man-Hours																	
Lineal Foot— Unflanged 150# Pipe	.4	.4	.4	.4	.50	.54	.54	1.0	1.0	1.5	1.5	2.0	2.0	2.5	3.0	3.0	3.5	4.0
Lineal Foot— Unflanged 250# Pipe	.5	.5	.5	.5	.6	.7	.7	1.2	1.2	1.8	1.8	2.4	2.4	3.0	3.6	3.6	4.2	4.8
Flanged Joint—150#			1.5	1.5	1.5	1.5	1.5	1.5	2.2	2.2	2.2	2.9	2.9	2.9	3.5	3.5	4.0	4.0
Flanged Joint—300#			1.6	1.6	1.6	1.6	1.6	1.6	2.4	2.4	2.4	3.1	3.1	3.1	3.8	3.8	4.4	4.4
Elbows 45°-90°-150#	1.0	1.0	1.0	1.0	1.0	1.3	1.5	2.3	3.5	5.0	7.0	9.0	11.0	12.0	13.0	13.0	14.0	14.0
Elbows 45°-90°-300#	1.1	1.1	1.1	1.1	1.1	1.4	1.6	2.5	3.9	5.5	7.7	9.9	12.1	13.2	14.3	14.3	15.4	15.4
Tee—150#	2.0	2.0	2.0	2.0	2.0	2.2	2.4	3.4	5.0	6.5	8.5	10.5	12.5	13.5	14.5	14.5	15.5	15.5
Tee—300#	2.0	2.1	2.1	2.1	2.1	2.3	2.5	3.8	5.5	7.2	9.4	11.5	13.7	13.7	15.9	15.9	17.1	17.1
Valves—150#				1.5	1.5	1.5	1.5	3.0	3.7	4.7	6.0	9.0	11.0	12.0	12.5	13.5	20.0	24.0
Valves—300#				1.6	1.6	1.6	1.6	3.3	4.0	5.2	6.6	9.9	12.1	13.2	13.8	14.8	22.0	26.4
Blank Flanges—150#				.5	.5	.6	.7	1.3	1.7	2.5	3.5	4.5	5.5	6.0	6.5	6.5	7.0	7.0
Blank Flanges—300#				.5	.5	.7	.8	1.4	1.8	2.7	3.8	4.9	6.0	6.6	7.1	7.1	7.7	7.7
Reducer—150#					.9	1.2	1.4	2.3	3.2	4.5	6.3	8.1	9.9	10.8	11.7	11.7	12.6	12.6
Reducer—300#				1.0	1.0	1.3	1.5	2.5	3.5	5.0	7.0	9.0	11.0	12.0	13.0	13.0	14.0	14.0
Strainer—150#			1.5	1.5	1.5	1.8	2.0	3.0	4.0	5.5	7.5							
Strainer—300#			1.7	1.7	1.7	2.1	2.0	3.4	4.5	6.0	8.5							

oakum needed to caulk the joints, and to estimate the number of man-hours required to caulk these joints. When all the man-hours were extended and totalled they would show the total number of man-hours required for the job.

Where acid resisting cast iron pipe is called for, the labor performance would be the same as for the regular soil pipe.

We will next take a look at the other types of cast iron pipe and fittings, namely bell and spigot pipe and mechanical joint pipe.

These types of pipe and fittings are generally used in water distribution systems for towns and cities, and for service lines providing water for industrial and domestic use in factories, commercial buildings and homes.

They have a greater resistance to corrosion than steel pipe and last a good deal longer, thereby making a more economical installation in the long run. Tables 7 and 8 present man-hour performances covering these materials.

We will next show the application of labor for 150 and 250 lb pipe with 150 and 300 lb flanged fittings, flanges, valves and strainers.

These types of materials are generally used on the installation of water, steam and gas lines. To use the man-hours shown in Table 9, the estimator would list the linear feet of pipe (which is unflanged) and the fittings and valves, etc., and then apply the positioning man-hours shown against the individual items. In addition the joints must be counted and the man-hours for this item applied to get the total man-hours for the job. In estimating, don't forget to put flanges on the pipe, using appropriate data from Table 2 (June ACHV).

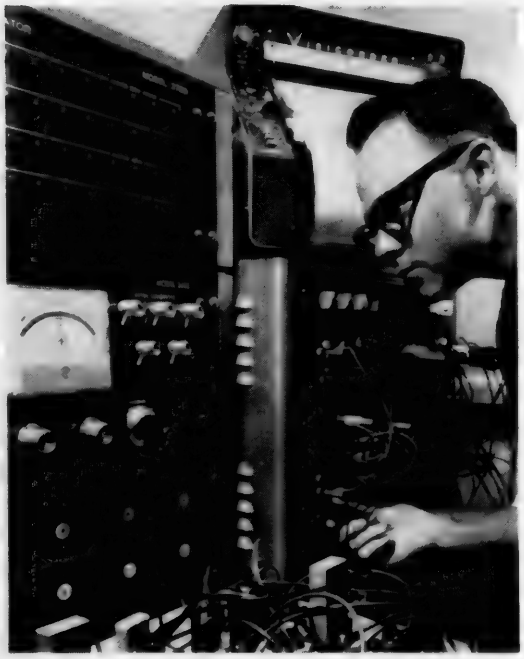
In future installments of this series, Job Time Reference Data will cover installation time for:

Stainless steel pipe and fittings
Plastic-lined pipe and fittings
Plastic pipe and fittings
Centrifugal pumps and sump pumps

THREE JOURNEYMAN PLUMBERS took 49 minutes, or 2.45 man-hours, to install a complete residential hydronic heating system in a 3-bedroom, 2-bath home in Crescent Hills colony, Allendale, N. J. Purpose was to demonstrate the feasibility of installing premium quality hydronic heating at no additional cost to buyers of lower-priced homes. The point was emphatically made using a boiler (seen at left) manufactured by Hydrotherm, Inc., baseboard radiation and new nailing tool (shown below) from Slant/Fin Radiator Corp., and flexible metal connections made by Hydro-Flex Corp.

Picture Paragraphs

AIR CONDITIONED ALAMO turned the clock back at this historic shrine of Texas liberty in San Antonio. Installation of General Electric Weathertron heat pumps permitted removal of steam radiators, pipes, and paddle-blade fans, leaving the walls virtually uncluttered, much as they were back in 1836 during the Battle of the Alamo. Supply outlets for air handling units are heavy hand-wrought iron window grilles, typical of 18th century Spanish churches, chemically aged to lend an authentic touch.



MINUTES EQUAL MONTHS on this new analog computer used by Minneapolis-Honeywell temperature control engineers to duplicate climate and building conditions anywhere in the world. Computer inputs simulate outdoor temperatures, wind direction and velocity, diurnal solar variations, latitude and cloud cover; also, building size and construction, glass area, insulation, air conditioning requirements, piping and ductwork.

air conditioning the ELECTRONIC R & D CENTER

C. STUART PERKINS
and
ROBERT F. COYNE
Albert C. Martin and Associates
Architects and Engineers
Los Angeles, California

air conditioning LABORATORY ANIMAL QUARTERS

ROBERT F. CROSSMAN
and
RALPH ELSEA
Carrier Air Conditioning Company
Syracuse, N. Y.

July, 1961

AIR CONDITIONING, HEATING AND VENTILATING's
REFERENCE SECTION

PERKINS

C. Stuart Perkins received his BSME from the University of Minnesota in 1935. Following employment with General Electric as a design engineer, he joined the Detroit architectural firm of Smith, Hinchman and Grylles as a mechanical engineer specializing in heating, refrigeration, and process piping. During World War II he supervised preparation of flight control data for Minneapolis-Honeywell and prepared design criteria on government maintenance projects for the AEC. An ASHRAE member, he is presently head of the mechanical department, Albert C. Martin and Associates, architects and engineers of Los Angeles.

Robert F. Coyne, received his BSME from the University of Santa Clara, California in 1950. After service as an artillery officer during the Korean War, he joined the building construction firm of George A. Fuller Company, New York, as a field mechanical-electrical engineer on construction projects in Ohio, New York and California. He joined Albert C. Martin and Associates in 1956, as mechanical project engineer on commercial and industrial installation. He is also a member of ASHRAE.

COYNE

Air Conditioning the Electronic Research and Development Center

Design, construct, and occupy within twelve months—that is the norm established by the rapidly expanding electronic research and development industry. Design must enable partitions, equipment and utilities to be rearranged as needed, provide for future expansion, and solve the special problems of the physical environment.

A successful air conditioning system for the R & D Center is the end result of a detailed study of design criteria, types of generating systems, methods of air distribution, degree of temperature control, first cost, operating cost, architectural appearance and ease of maintenance. Herein are guidelines that will prove useful in such a study.

SPECIAL REQUIREMENTS for air conditioning the research and development center constitute no new design considerations in connection with the normal heating and cooling load estimate, except that these requirements are considerably more intensified. The varied problems presented to research centers require frequent changing of design teams and laboratory facilities. Furthermore, pleasant surroundings and expansion potential are mandatory for a new industry that employs personnel who have achieved a high level of education and professional experience. Scientific personnel who will occupy such a center constitute a unique group. The average scientist has a high educational status, high income, and most important, individuality.

Since quality performance of this group is essential to the success of the company, every effort is made to provide the best working conditions. This is normally accomplished by providing private, two-, or four-man offices and conference spaces on the perimeter areas of single or multi-story buildings, with laboratories, service and special equipment areas concentrated into central spaces. Extremely large glass window areas on the perimeter offices overlooking a pleasing exterior environment are desirable.

Naturally, this greatly complicates the problems of solar load control throughout the year. The solution, which is a joint effort of the architect and the air conditioning designer, must provide a happy medium between appearance and increased refrigeration load. Several very satisfatcory solutions have been found in various combinations of tinted solar glass, projection overhangs, and decorative sun screens. Each solution is a working compromise between aesthetics and mechanical efficiency. Interior laboratory areas, where electronic devices are assembled, tested, and utilized on research projects, are notorious for extremely high power loads, at times averaging 30 watts per sq ft, and, in special situations, 175 and higher foot-candle lighting loads. Diversity and flexibility factors are often present, therefore each project requires special interior load analysis so that the all important comfort condition of these working spaces can be maintained at minimum cost.

Extra attention beyond that required for normal comfort conditions should be given special work areas, such as photographic studios with high-intensity floodlighting and blackout provisions; computer areas with intricate temperature and humidity relationships; and "white" rooms, with their delicate air filtration problems. The area of micro-wave and radar penthouse with special antenna installations, makes the location of mechanical roof mounted equipment critical, but not prohibitive with respect to line of site, proximity of metal, and the problems created by chemically treated cooling tower water sprays.

Design Criteria

The following criteria have proven quite satisfactory as a general design basis for research and development centers in Southern California. These criteria are always reviewed and modified when necessary to suit specific requirements of the installation:

Outdoor Conditions

Summer	*Winter*
95 to 105 deg F db	30 to 40 deg F db
70 to 75 deg F wb	30 to 40 deg F wb

Indoor Conditions

Summer	*Winter*
75 deg db	75 deg db
62½ deb wb	

Occupancy Conditions

Metabolism rate is based on moderately active office work. Occupancy load is based on approximately one person per 60 sq ft in office and one person per 100 sq ft in laboratories.

Ventilation Conditions

1. Use 20% minimum outside ventilation air with provisions in special cases for 100% outside air conditions.

2. Building pressurization is maintained at 3% maximum of total air supply quantity.

3. All conference and coffee rooms are 100% air exhausted.

4. Janitor and toilet rooms receive, either through a primary or secondary supply, 15 air changes per hour with 100% mechanical exhaust.

5. Inclosed stairwells receive 12 air changes per hour mechanical exhaust.

6. Occupied office areas receive a minimum 15 air changes per hour with exact air quantities subject to cooling and heating load analysis.

Air Velocity Conditions

1. Main supply duct air velocity: 2000 fpm maximum on low pressure systems, 4000 fpm on medium pressure systems.

2. Branch duct velocities: based on 0.1-inch SP per 100 lineal feet of duct.

3. Neck velocity at diffusers: not to exceed 850 fpm.

4. Air velocity at cooling coil: not to exceed 550 fpm.

5. Air velocity at heating coil: not to exceed 700 fpm.

6. Return, exhaust, or outside air grille face velocity: not to exceed 450 fpm.

Filtering Conditions

1. Replaceable media glass fiber air filters with strainer mat as *minimum* filter on all outside and return air systems.

2. Electrostatic and carbon filters in air stream: only if required by special people or equipment occupancy.

Zoning Conditions

1. Executive offices, corner exterior offices, conference rooms, and appropriate adjacent offices: provided with individual controls.

2. Other offices and normal interior spaces: provided with area zone control on a square foot basis of 1000 to 2000 sq ft each.

3. Special laboratory or equipment areas: independently and individually controlled.

4. Exterior offices or areas: zoned by exposure and controlled by space thermostat with outdoor temperature compensator.

Types of Generating Systems

Four possible mechanical solutions are available to provide air conditioning, heating and ventilating to any given research and development center, namely: unitary, building central, building package, and project central. Each center must be thoroughly analyzed with regard to the four solutions to determine accurately which is the acceptable choice.

The *unitary* approach employs self-contained gas or electric package units strategically located in the space, suspended under or mounted on the roof. See Fig. 1. This system has many advantages and disadvantages.

The advantages are: very low first cost, minimum costly floor space required, very short duct runs, units that can easily be replaced if failure occurs. It also simplifies the problem of breaking a lease. The electric all-year (heat pump) package units offer additional advantages in low silhouette and elimination of all water piping and water treatment.

The disadvantages are: problems of increased maintenance, higher operating cost, lack of zone standby capacity, and poor architectural appearance (unless roof mounted equipment is hidden by a decorative screen). Normally, defense-oriented and financed research and development centers are primarily interested in satisfactory operation of the air conditioning system at minimum first cost.

A *building central* system consists of either basement or roof-mounted equipment capable of generating (with steam boilers and absorption refrigeration equipment, or electrically powered centrifugal refrigeration equipment and gas/oil-fired hot water boilers) the heating and cooling water media for distribution

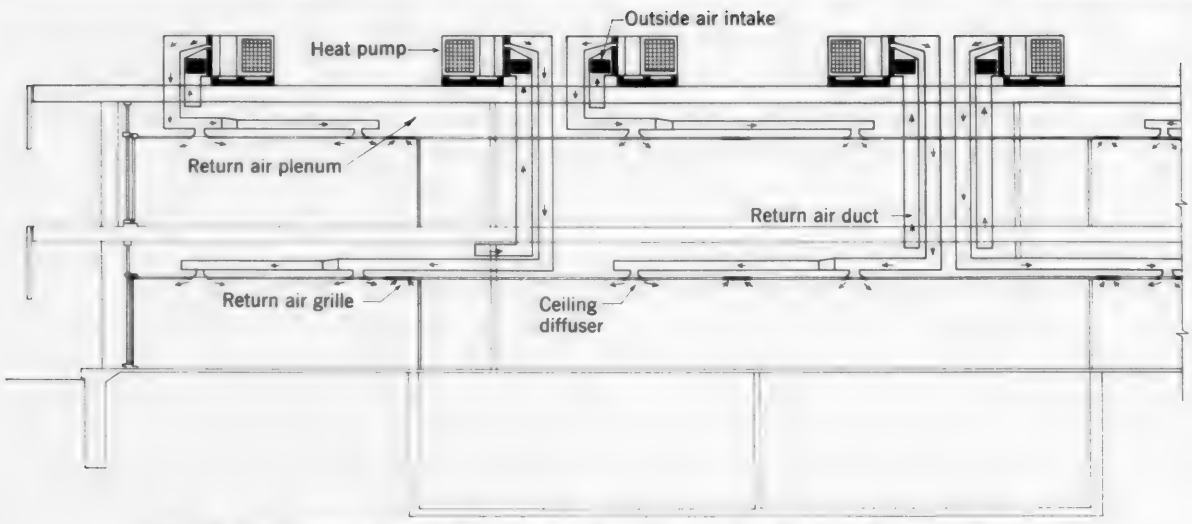


Fig. 1. The unitary approach employs self-contained gas or electric package units strategically located in the space, suspended under, or, as here, mounted on the roof.

to either central or remote fan stations in the individual building. See Figs. 2 and 3. Advantages of this approach are similar to those of the unitary approach, except that initial costs are higher and the basement is sometimes not available for mechanical equipment. However, as a plus advantage, operating and maintenance costs are considerably lower than in unitary systems. Disadvantages of this system include water treatment at each building and the probability of a standby fuel oil system for the heating boiler.

The *building package* system consists of either basement or roof-mounted hot water or steam boiler assemblies and a roof-mounted cooling tower. Heating and condenser water piping run to self-contained fan-compressor package assemblies located throughout the building in advantageous positions. See Fig. 4.

Advantages of this system are: first cost is less than the building central system, supply duct runs are a minimum, return air is taken from the space adjacent to the package unit. Disadvantages are: increased maintenance, use of expensive floor space and, in some cases, noise and vibration.

Project central systems provide a central heating and cooling water generating plant for the entire site with water pumped through insulated overhead or underground piping to individual building fan stations. See Fig. 5. Advantages are: centralized maintenance for the main equipment units, best architectural appearance, central fuel oil standby system, and emergency building refrigeration and heating capacity with no increase in equipment size or number. Disadvantages are: high first cost, long piping distribution runs, large-volume water treatment, and the necessity of metering the heating and cooling systems if resale of property is considered.

Types of Air Distribution Systems

Several general types of air distribution systems have been successfully employed in R & D facilities. Medium- and low-velocity double-duct systems and low-velocity multizone duct systems are primarily associated with the building central and project central systems. Unitary and building package systems utilize low-velocity single ducts to distribute the air as the unit cycles through heating, ventilating, and cooling stages.

Standard duct construction and hangers are employed on all systems. A special climatic condition encountered in Southern California often allows reduction of the cold-hot duct size ratio from the standard 100-75 to a more economical 100-40. Return-air ceiling plenum systems with short trunk ducts back to air handling equipment have been used extensively and satisfactorily, except in special offices and conference rooms where possible cross talk through plenum space might be objectionable. Air handling equipment has varied from the factory-built package assembly to the complete, field-fabricated installations. The actual type selected is a function of cost, air quantities required and equipment space available. The trend is to more factory-built, unit installations.

Exterior ducts exposed to weather are insulated on the inside of the duct, with all joints sealed with a pliable plastic weatherproof cement. Interior building ducts receive standard thermal wrapping with taped-on joints. Canvas-jacketed insulation is used on exposed ducts, with interior acoustic lining applied in special quiet areas.

Types of Temperature Control

Temperature control systems have run the complete cycle of electric, pneumatic, electronic, and various combinations. The unitary and building package

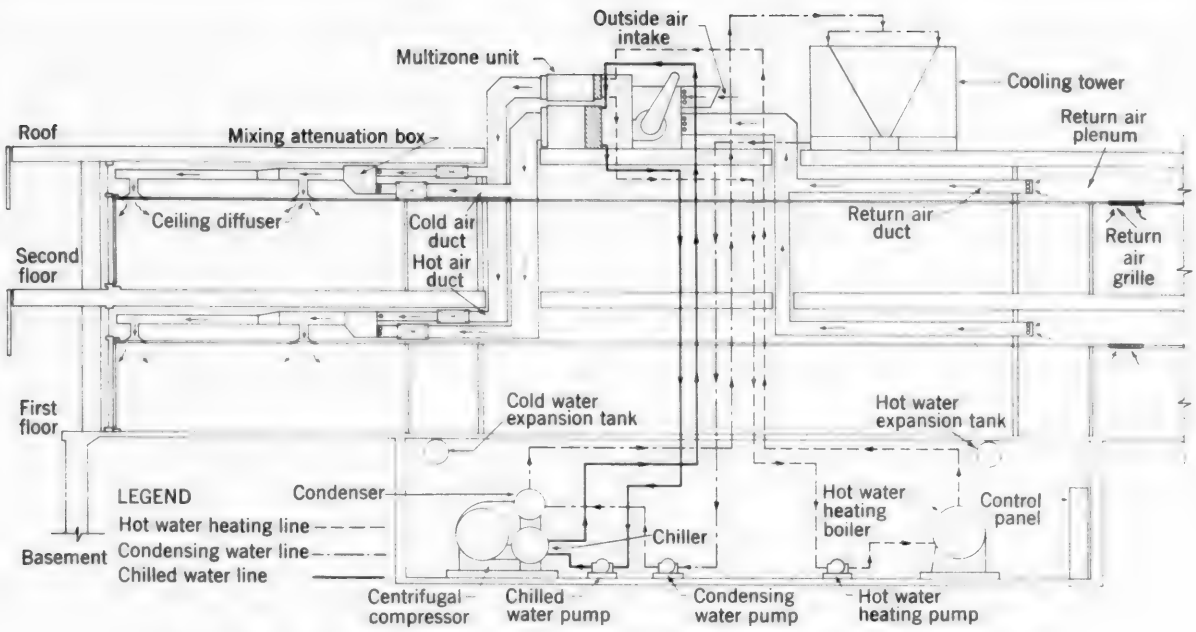


Fig. 2. One form of the building central approach consists of a central system in the basement generating hot and chilled water to feed a roof-mounted multizone unit that supplies all floors with conditioned air.

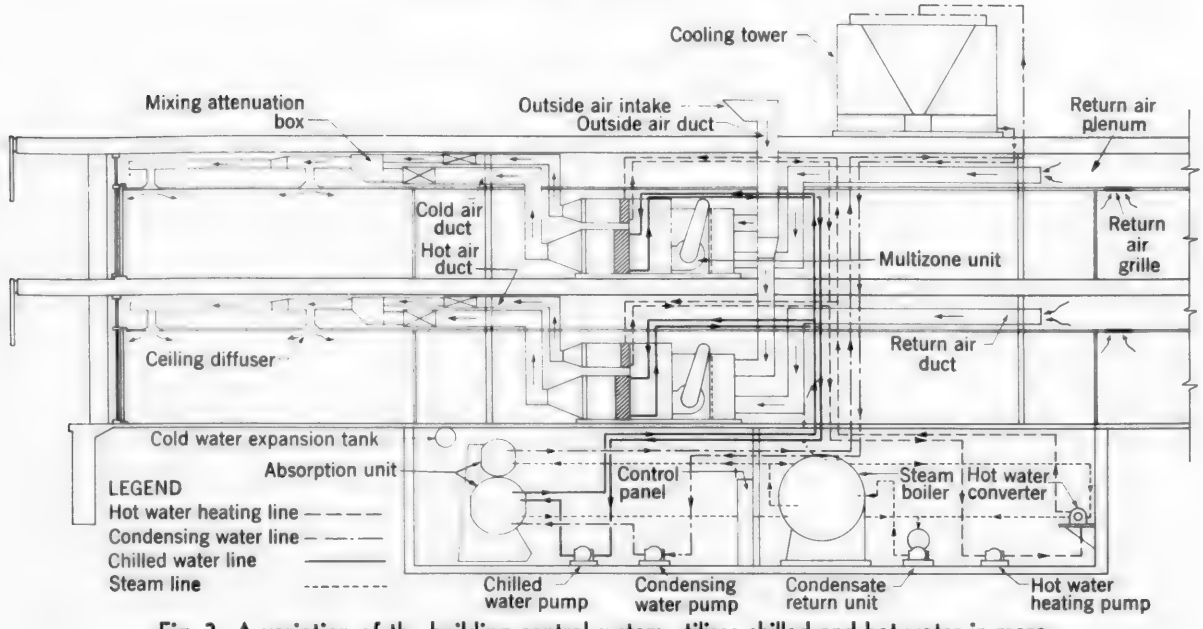


Fig. 3. A variation of the building central system utilizes chilled and hot water in more than one multizone unit for supply of conditioned air to each floor.

system normally incorporates a simple electric heat-vent-cool cycle on a zone thermostat with a program device that will prevent all the unitary compressors of the project from starting at the same time, following a possible power failure. Building central installations have been either pneumatic or electric with the initial projects having the mechanical equipment started and stopped locally. With more recent projects there is a definite trend to a remote temperature control console location from which operation and limited trouble-shooting maintenance functions can be performed.

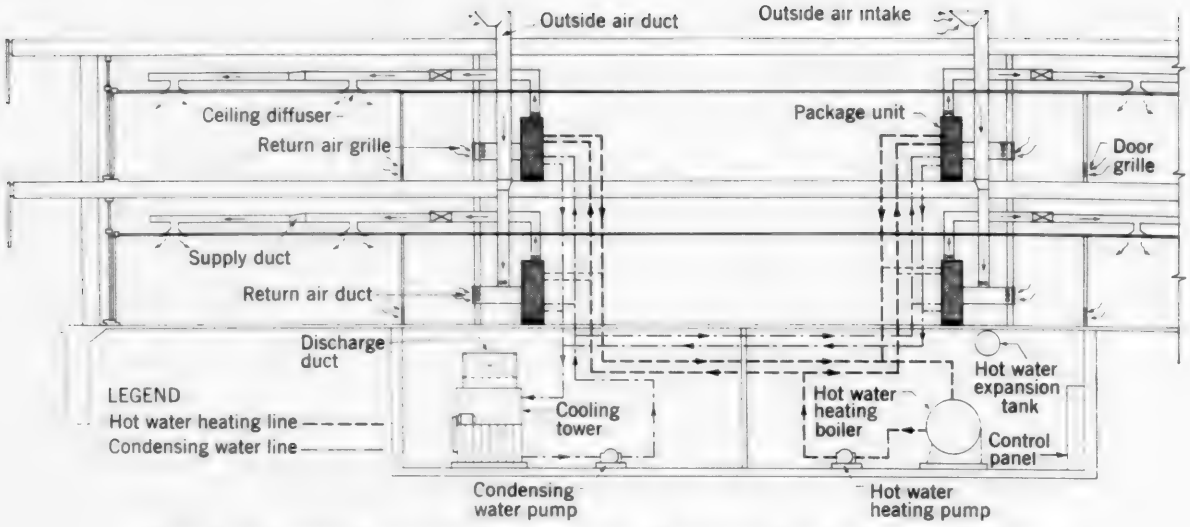


Fig. 4. The building package system consists of basement or roof mounted boiler assemblies and cooling tower. Heating and condenser water piping run to self-contained fan-compressor package assemblies located in strategic positions.

A project central installation makes the remote console an essential installation to control both the liquid and air mediums and to maintain the desired comfort conditions in the project buildings. The project central remote temperature control console most particularly demonstrates the ability of the installation to reduce, by a minimum of 25%, the number of maintenance personnel required.

Specific Examples

Examples of the foregoing principals are illustrated in the following Research and Development projects:

Space Technology Laboratory Facility, El Segundo Calif., consists of 850,000 sq ft of usable space in seven buildings housing approximately 4,500 people on a 40-acre site. A building central system was installed. In each building's basement is located self-sufficient generating equipment. Each building has approximately a 500-ton refrigeration load split between two 480-volt hermetic centrifugal chilled water compressors.

Heating water medium is produced by two gas-fired 60-bhp assemblies with oil standby. Each unit is selected at 60% of full capacity to provide a minimum of standby capacity. Penthouse-located, field built-up fan assemblies have double-duct air handling systems to distribute low-velocity supply air to each zone area. Each private office and/or laboratory constitutes an individual zone for the local pneumatic temperature installation. Normal utility services of hot and cold water, natural gas, and dry compressed air is supplied to each interior laboratory area for initial or future use.

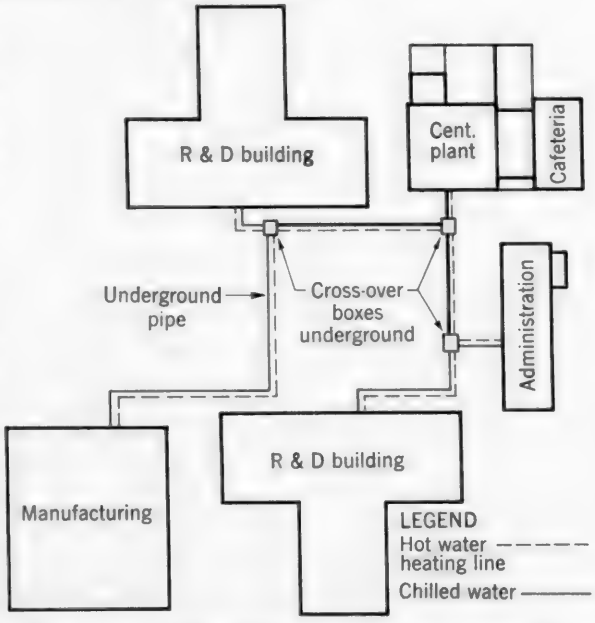


Fig. 5. The project central system starts with a central plant for generating heating and cooling media for distribution to individual-building fan stations.

Atomics International Division of North American Aviation at their new Canoga Park, Calif., facility has 243,000 sq ft in three buildings which house approximately 4,300 people on a 30-acre site. This facility utilizes the unitary system with approximately 1000 tons of refrigeration and 850,000 Btuh of heating supplied by packaged all-year heat pumps. Package installations are roof-mounted with each zone averaging about 15 tons refrigeration. Single,

low-velocity, insulated supply ducts distribute air to the occupied areas located immediately below the roof equipment.

An electric zone thermostat actuates the year-round heat pump cooling-ventilating-heating cycle in conjunction with an adjacent unit on-off switch. Future increases in air conditioning load can be simply offset with the addition of new units.

Large variable quantities of laboratory hood exhaust systems require considerable changing of the outside make-up air quantities on all the zone assemblies.

Special radioactive areas are conditioned by completely isolated systems. All return and exhaust air is completely filtered with high-efficiency mechanical filters to remove possible contamination. Continuous sampling of air systems by experienced personnel eliminates any radiation hazards.

All building areas are completely protected by sprinklers. Utility services supplied to the laboratory areas include hot and cold domestic and industrial water systems, compressed air, vacuum, natural gas, distilled water, and several inert gases.

Thompson-Ramo-Wooldridge Laboratories, Canoga Park, Calif., has nine buildings of approximately 800,000 sq ft to house 5,000 people on a 90-acre site. A project central system supplies hot and chilled water from a central plant to the laboratories and administrative building. Factory assembled fan-coil air handling units are installed. Four 4160-volt, 1250-ton hermetic centrifugal refrigeration compressors, in conjunction with three 250 hp natural gas and oil-fired hot water boilers, generate respectively 40-deg chilled and 200-deg hot water.

All hot, chilled, and condenser water pumping systems consist of groups of four parallel-connected, 480-volt water pumps; three of each group are in use, and the other is a standby. Condenser water (18,000 gpm) is pumped to three heat-rejecting, decorative spray ponds. The ponds are treated with chemicals to prevent algae growth; filters help maintain an efficient condenser water system.

Roof-mounted fan assemblies deliver air to occupied spaces through a modified medium-velocity hot- and cold-duct system. Zone temperature control is by area space load and compass exposure. An electronic-pneumatic temperature control console and system, with console located in the Utility Center building, provides for both trouble shooting and remote control of the site mechanical facilities. A standard independent building utility distribution system supplies hot and cold water, natural gas, and compressed air services to the interior laboratory areas.

A restatement of design concept for research and development installation, illustrates that the guiding influences of design as outlined in these pages would be low first cost, maximum flexibility, and the ability to expand the basic facility at minimum cost and disturbance.

Air Conditioning Laboratory Animal Quarters

The role of the laboratory animal in the development of antibiotics, tranquilizers, and other weapons against disease has proven invaluable. So has the part played by air conditioning. Herein is described how some systems for the latest biological laboratories have been designed.

WITHOUT AIR CONDITIONING, scientists could not adequately control variations in temperature and humidity in rooms where mice, rats, monkeys and other laboratory animals are used to test the effectiveness and safety of such medical weapons as penicillin, polio vaccine and other new and unfamiliar agents. Without air conditioning, environmental variables could be introduced which might lead to inaccurate and incorrect conclusions from experiments.

Air conditioning of animal facilities in research laboratories:

(1) Eliminates variations in temperatures and humidity which may have an effect on experimental results; (2) improves and insures the health of laboratory animals by permitting windows to remain closed, thereby reducing dust, dirt and sudden drafts that can chill and kill a delicate white mouse; (3) saves valuable laboratory space by putting many

CROSSMAN

Robert F. Crossman, manager of export unit engineering of Carrier Air Conditioning Co., a division of Carrier Corp., is a graduate of Syracuse University with a B.S. in mechanical engineering. He joined Carrier in 1951 as an application engineer in the Syracuse home office, became a senior engineering instructor in 1954, then moved on to unitary equipment engineering. In 1958 he was named to his present post. He is a member of ASHRAE and a professional engineer, registered in New York. He is the author of several articles on air conditioning.

Ralph Elsea, senior application engineer for Carrier Air Conditioning Co., joined the company in 1945 upon his discharge from the Air Force. His first assignments were as draftsman and branch engineer in the St. Louis office. In 1951 he became a project engineer in the Chicago office. He was assigned to the Syracuse home office in 1953 as an application engineer with major responsibilities in system design. He was named to his present post in November, 1960. He is a graduate of the Missouri School of Mines and Metallurgy, with a B.S. in mechanical engineering.

ELSEA

more animals in a room than would otherwise be possible; and (4) perfects the breeding of these animals in quantity and quality, guaranteeing a dependable supply.

Design Standards

The first step in system design should be consultation with the scientists involved. The ultimate goal of the research program will determine the design standards. In many cases, human comfort conditions (about 76 deg F and 55% rh) are adequate to maintain the health of animals in research work. The most important factor is that both temperature and humidity remain fairly *constant*.

Heat load from these animals depends on the species and number to be housed in a room.*

Another primary consideration is that the animals have a *draft-free* environment. Number of air changes per hour, however, must be sufficient to keep odors to a minimum for the benefit of laboratory employees. A common rate is 12 air changes per hour. Animal odors cannot be eliminated without the expensive and time-consuming process of washing each animal. But odors can be minimized if personnel are good housekeepers and change bedding and cages frequently.

The best way to combat odors is to introduce and exhaust 100% outside air. This vital and nearly universal requirement not only prevents odors and bacteria from recirculating and concentrating, but also avoids constant cleaning of filters clogged with animal hair and dry food particles.

For most applications, the use of all outside air virtually eliminates standard self-contained apparatus. The cooling coil in this equipment is inadequately sized for handling the heat load of the outdoor

* See Handbook of Air Conditioning, Heating and Ventilating for Heat Conversion of Animals, p. 1-163; Conditions for laboratory animals, p. 1-293.

Fig. 6. Part of the complex of 20 individually air conditioned animal breeding buildings at the U.S. Army Biological Warfare Laboratories at Fort Detrick, Md.

air generally required. In addition, these applications often require more horsepower when packaged units are used.

Equipment and system performance must be *dependable* to avoid costly repeating of experiments.

Applied Systems

An applied system, tailored to the job, is the answer for small laboratories or for animal quarters in larger facilities. More than 5,000 animals of different species are located in portions of a fully air conditioned three-story building of Bristol Laboratories, a pharmaceutical house in Syracuse, N. Y. A complete remodeling of the building eight years ago included the installation of two applied systems to serve three animal rooms and four small pharmaceutical laboratories. Additional systems handle the remainder of the building.

Two animal rooms, containing mice, rats and guinea pigs, are held at 76 deg F, plus or minus one degree. Two 40-ton reciprocating condensing units on an outside loading platform supply refrigerant by direct expansion to two fan-coil units of 2,000 and 6,500 cfm. The latter are installed over false ceilings in each room as a space economy measure, and they supply 100% outdoor air through ceiling diffusers.

Exhaust outlets are placed high on the walls to remove heat rising from the animals and to facilitate wall washing. The exhausts are vented directly outside so that odors do not penetrate other areas.

A second system of 25 tons capacity serves rabbits located in two connecting rooms, one of 600 sq ft and the other 400 sq ft. Because rabbits like it cooler, a temperature of 68 deg is maintained.

All these areas operate on 15 air changes per hour, slightly higher than usual for this application. This feature, combined with good house-cleaning, minimizes odors despite the high animal concentration. Air is recirculated in the four laboratories, but not in the animal rooms.

"Air conditioning is of utmost importance in our work," says Dr. Merle H. Pindell, head of the department of pharmacology. As an example, "every batch of drugs produced by Bristol for injection in humans is first tested on rabbits. If there is even a minute amount of foreign matter present, it will cause a fever in the animals. And if the increase in body temperature is greater than six-tenths of a degree, the entire lot is discarded. As a result, we rely on air conditioning to prevent an externally induced variability in the animal's body temperature in order to standardize conditions maximally.

"We purchase our animals from suppliers, paying up to 30 cents for a mouse, $2 for a guinea pig and $3 for a rabbit. If we were breeding our own animals, air conditioning would be even more important."

Fig. 7. Conditioned air for breeding room at Fort Detrick enters through ductwork at ceiling, then flows down behind perforated "live wall" and into room. Another live wall across the room picks it up, allowing 12 draft-free air changes per hour.

Animal Farm

One of the largest animal breeding farms in the world is at Fort Detrick, the U. S. Army Biological Warfare Laboratory at Frederick, Md. Unlike other such farms, it sells no animals but supplies its own laboratories that are dedicated to the creation of invisible weapons of war, and to defenses against them. The farm was built in 1953 to (1) control animal quality, (2) make sure the supply meets the demand, and (3) breed species impossible to purchase elsewhere in sufficient quantity or quality.

At any given time, the population of this farm will include about 35,000 mice, 25,000 guinea pigs, 500 rabbits and 250 monkeys. All but the monkeys are born on the farm.

The animals are housed in 20 single-story concrete block buildings, 16 containing three rooms and four with two larger rooms. See Fig. 6. The three-room structures each have their own 15-ton applied system. The two-room buildings house monkeys and rabbits, whose higher heat output requires 30-ton systems. All chilling cycles are of the direct expansion type.

The reciprocating compressors unload on capacity control down to one cylinder. And each of the 56 windowless rooms has its own 1,000 cfm fan coil unit, complete with preheat and reheat coils, floor-mounted in an anteroom.

The systems, designed by Fort Detrick engineers,

are unusual in two respects—the method of air distribution and the use of 15% recirculated air.

As many as 6,000 mice or 1,200 guinea pigs may be stacked in cages 5 ft high around the 484-sq ft rooms, yet temperature and humidity are held constant at what is considered optimum at the farm for each species. This is 80 deg for mice, 74 deg for guinea pigs, 70 deg for rabbits, 78 deg for monkeys, and 50 to 60% relative humidity throughout.

Twelve air changes per hour are draftlessly circulated with the aid of what is called a "live wall." See Fig. 7. This technique involves ducting conditioned air from the central apparatus at ceiling height into a four-inch-deep plenum between a normal wall and one made of perforated panels. Air flows gently into the room, through and around the cages, and out through another live wall on the opposite side of the room.

At this point, 85% of the room air is pushed out of the building by positive pressure within the room (new animal quarters now being built will use fans to exhaust the air).

The remaining 15% room air is returned to the central air handling device through a cleanable filter which is serviced twice a week. This is because the thermostat and hydrostat are placed in the return duct at the unit. While this recirculation is not ideal from an odor standpoint, it does provide precise temperature and humidity control, the primary requirement at Fort Detrick.

"A major portion of the research here involves the use of animals," says Dr. Melvin M. Rabstein, chief of the animal farm and president of the national Animal Care Panel. "In order to assure a steady flow of animals, it is vital that we control every point of production. For example, reproduction in animal colonies without air conditioning drops to a very low level during the summer months. Conversely, low winter humidity can result in high mortality rates among suckling mice."

Central System

The design of an air conditioning system for large laboratory buildings housing research animals differs from any big building system mainly in air distribution, exhaust and the use of 100% outside air. The new three-story, aluminum-and-glass occupational and environmental health laboratory building for the Wayne State University College of Medicine, Department of Industrial Medicine and Hygiene, in the heart of Detroit, offers an example. It has been in operation one year.

At present the department is studying the effects on the lungs of breathing: (1) beryllium, for the American Cancer Society; (2) city street air, for the U. S. Public Health Service; and (3) radioactive material, for the Atomic Energy Commission. All of these experiments involve nearly 5,000 animals including monkeys, rabbits, guinea pigs, rats and mice.

"Those animals were a major factor in designing an air conditioning system for this building," says

Fig. 8. An ambient air room at the Wayne State University College of Medicine in Detroit is equipped with a 5-ton packaged unit to keep room temperatures near normal despite ambient raw city air.

Fig. 9. Static pressure gages in corridor keep tabs on positive pressure inside ambient- and clean-air rooms at Wayne State University. Design prevents infiltration of clean air.

Jack Yorke of Hyde & Bobbio, Inc., Detroit consulting engineers. "Each room had to be treated individually, depending upon the type of research conducted there, with static pressures within the room either higher or lower than the adjacent corridors to prevent infiltration or exfiltration."

The heart of this system is a 60-ton absorption machine, powered by steam from the nearby Public Lighting Commission plant. This machine supplies 45-deg chilled water to five fan-coil units ranging from 1,200 to 3,650 cfm. The units are hung from the ceiling as close as possible to the rooms they serve and maintain conditions of 78 deg and 50% relative humidity.

Three additional air handling units, of 1,800 to 6,650 cfm, are used for ventilation only. Two of these supply air to storage areas and other places where conditioned air is not necessary. The third ventilating apparatus makes this installation unusual. It pulls raw city air from street level into two ambient air rooms where animals breathe it and are studied for possible lung effects. This air is then exhausted directly to the outside.

The problem was how to keep these animals alive in very hot weather. The rooms obviously could not be conditioned from the central system, which would introduce filtered air and destroy the experiment. The answer was packaged units, one of the few applications this type of equipment has in an animal research laboratory. In hot weather, these units recirculate cool, unfiltered air when needed. See Fig. 8. Heating is accomplished, as it is throughout the building, by perimeter radiation.

To prevent conditioned air in the corridor from infiltrating rooms containing ambient air, static pressure regulators, set to 0.1 inch of water higher than corridor air, sense any pressure drop and adjust dampers behind the exhaust register. For example, these dampers automatically close when the door is opened. Static pressure inside the room can be read on gages on the corridor wall next to the door. A red light remains on until the door is properly closed. See Fig. 9.

Adjacent to these ambient-air rooms are two clean-air rooms, containing colonies of animals of the same family as those breathing dirty air next door. This is the control colony, which gives scientists a yardstick by which to measure the reactions of animals in the ambient air rooms. Air for the clean rooms is not only filtered before being conditioned by the central plant, but it is also cleaned by activated carbon and high efficiency mechanical filters which remove odors and nearly 100% of all airborne particles down to and including some forms of bacteria.

Except for the ambient-air rooms and certain storage spaces, conditioned air is distributed at low velocity to the various rooms through overhead diffusers and exhausted directly to the outside. No air

Fig. 10. Special chambers segregate animals exposed to radioactive materials at Wayne State University. Chambers are supplied with conditioned and filtered room air by small blowers on top of each chamber. Exhaust is similarly filtered and can be discharged through holes in the ceiling connected to the building's system, or through outlets over the windows. Auxiliary fans mounted on building columns near ceiling make exhaust from chambers to outdoors positive.

Fig. 11. Animal rooms and adjacent laboratories are air conditioned by a low-pressure central system at Parke, Davis & Company in Ann Arbor, Mich. Air is supplied through slots in lighting fixtures, and ceiling exhausts pull odors directly to the roof.

is recirculated. The corridors depend on the rooms for their supply.

One area in which static pressure is slightly below that of the corridors is the radioactive room. This is to prevent possible contamination from entering the corridor in the event of spillage or other accident. Within the room itself are seven hermetically sealed stainless steel and plexiglass chambers in which animals exposed to radiation are segregated. See Fig. 10. These chambers are supplied conditioned room air through blowers on top of each. All air is cleansed by passing through high efficiency mechanical filters before entering a chamber. The exhaust is similarly filtered before it is discharged into the building's exhaust system or directly outside. Laboratory personnel work with the animals through special arm-ports with built-in rubber gloves.

There are two separate exhaust systems for the protection of the 40 people working in the building. One handles conditioned air. The other is connected to laboratory hoods for swift and efficient removal of noxious agents. To prevent corrosion by airborne acids, this system is composed of polyvinyl chloride ducts and a roof-mounted fiberglass fan.

"Without air conditioning, it would not be possible for us to carry on these experiments," says Edward Urban, associate professor and industrial hygienist.

Multi-Purpose System

One of the newest central systems is at the year-old research laboratories of the pharmaceutical organization, Parke, Davis & Co., Ann Arbor, Mich. This ultra-modern complex of three buildings is served by 2,100 tons of absorption refrigeration, an unusually high tonnage because of the use of 100% outside air in all but the administrative building.

Chilled water and steam from a central powerhouse is piped underground to the three buildings, most of it going to the main laboratory. This three-story building of 120,000 sq ft has 91 pharmacology and chemistry laboratories and 35 animal rooms. The latter are all in the pharmacology wing, which comprises half the building.

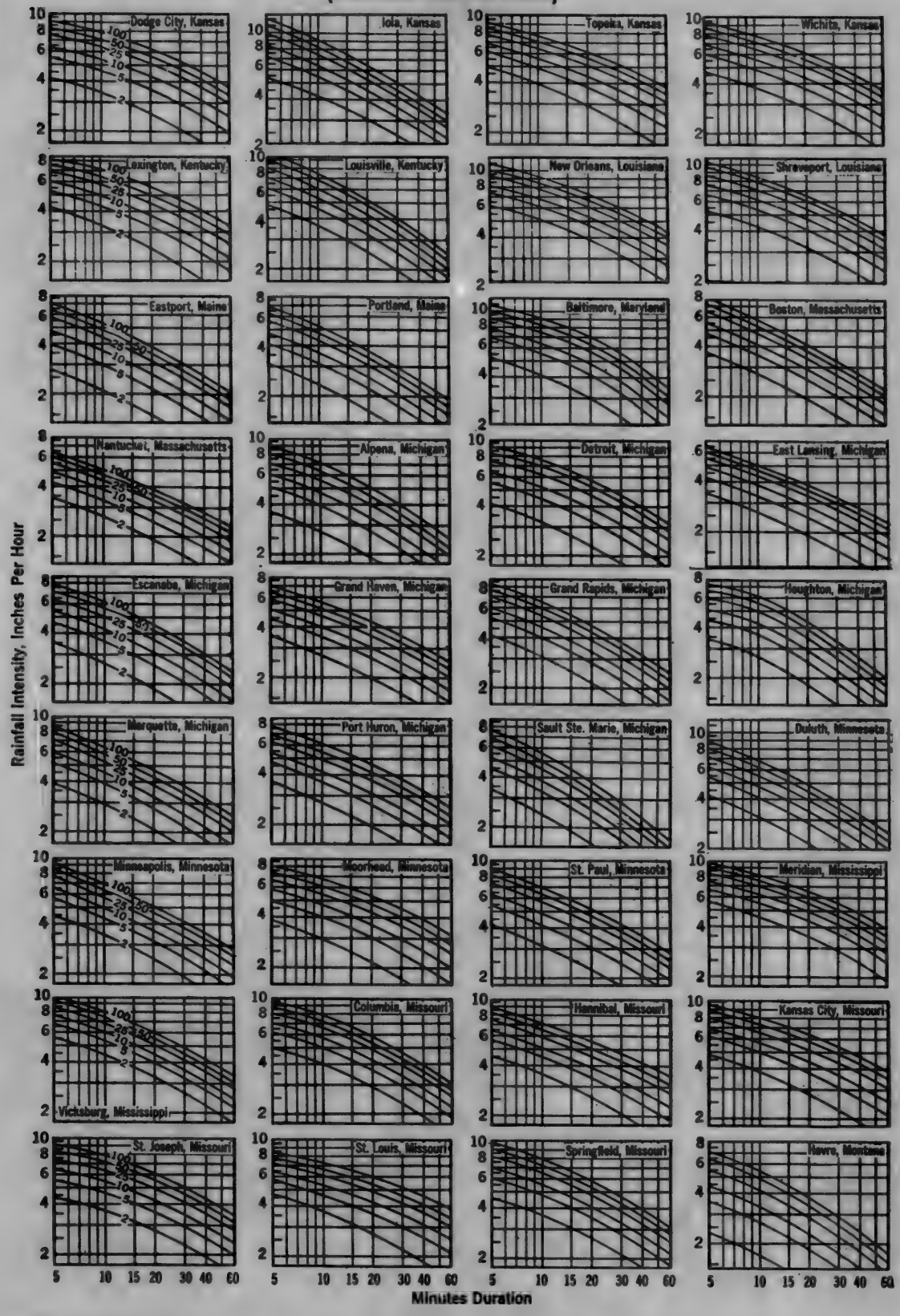
The air conditioning system for this and the other buildings was designed by architects Skidmore, Owings and Merrill in cooperation with Parke-Davis scientists and engineers. It is essentially a low pressure, zoned system with hot water terminal reheat, allowing individual thermostatic control in each laboratory and animal room. Air is taken in at ground level at both ends of the building through electrostatic and dry-type filters, then distributed at low velocity to corridors on the periphery of each floor, and to interior zones. The corridors act as insulating barriers from outside weather for the labs.

In the pharmacology wing, each laboratory has its own animal rooms, segregating animals by research project and enabling researchers to keep close watch on their experiments. See Fig. 11. Air enters these rooms through slots in the light fixtures and is exhausted through the ceiling directly to the roof. There are 44 exhaust fans in this building alone, plus 104 laboratory hood exhausts. Negative pressure inside the animal rooms and their adjoining laboratories prevents odors from escaping into the peripheral corridors and the service corridors in the core of the building.

The air conditioning of small animal quarters in research laboratories will continue to play an important role in man's effort to conquer disease. Because of the wide variety of requirements to be met, no one system or design will fit all applications. It is up to the experienced design engineer and the scientist jointly to develop the best possible system for the welfare of mice and men.

RAINFALL INTENSITY-DURATION-FREQUENCY CURVES

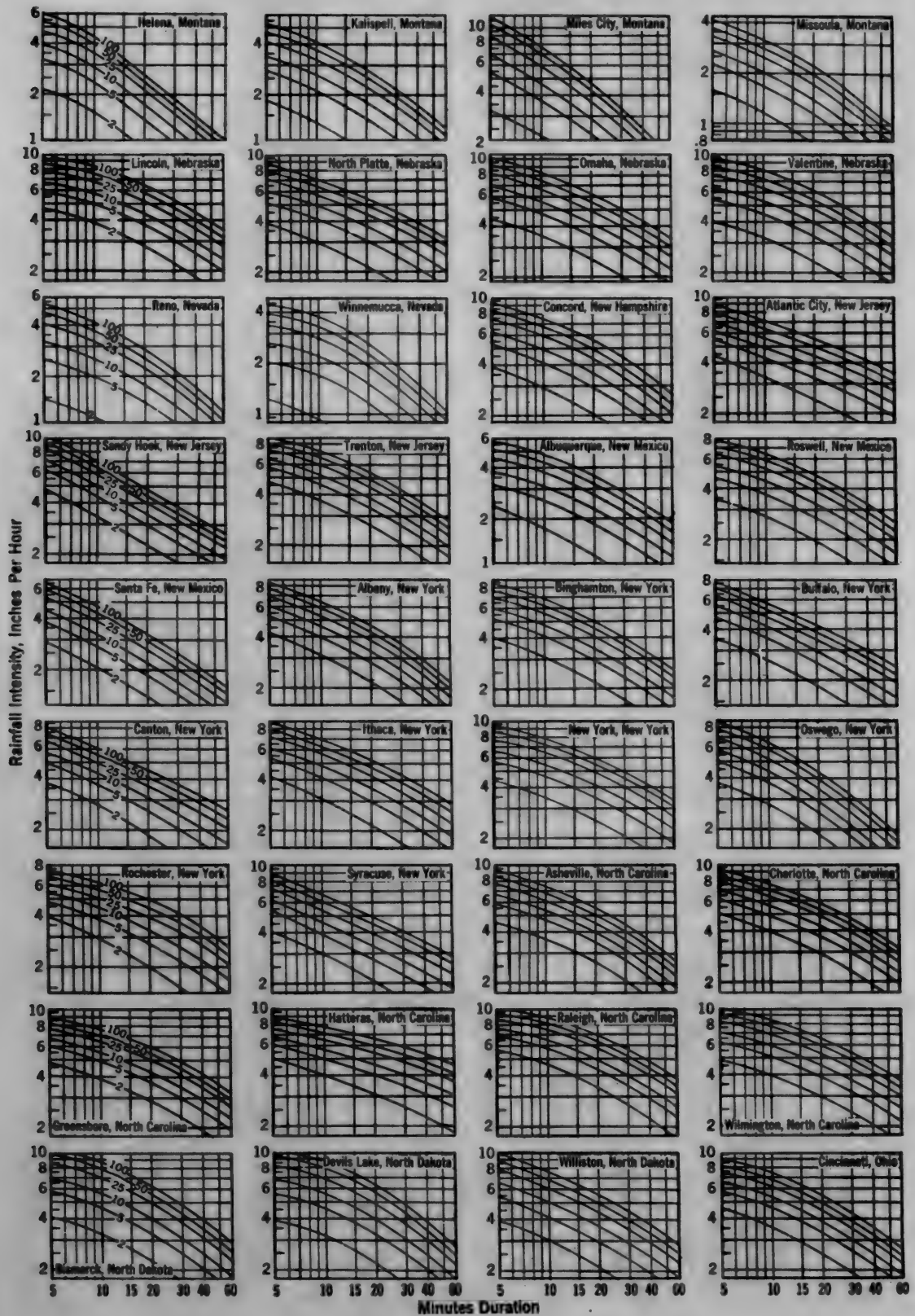
(Continued from last month)



REFERENCE DATA—AIR CONDITIONING, HEATING AND VENTILATING

July, 1961

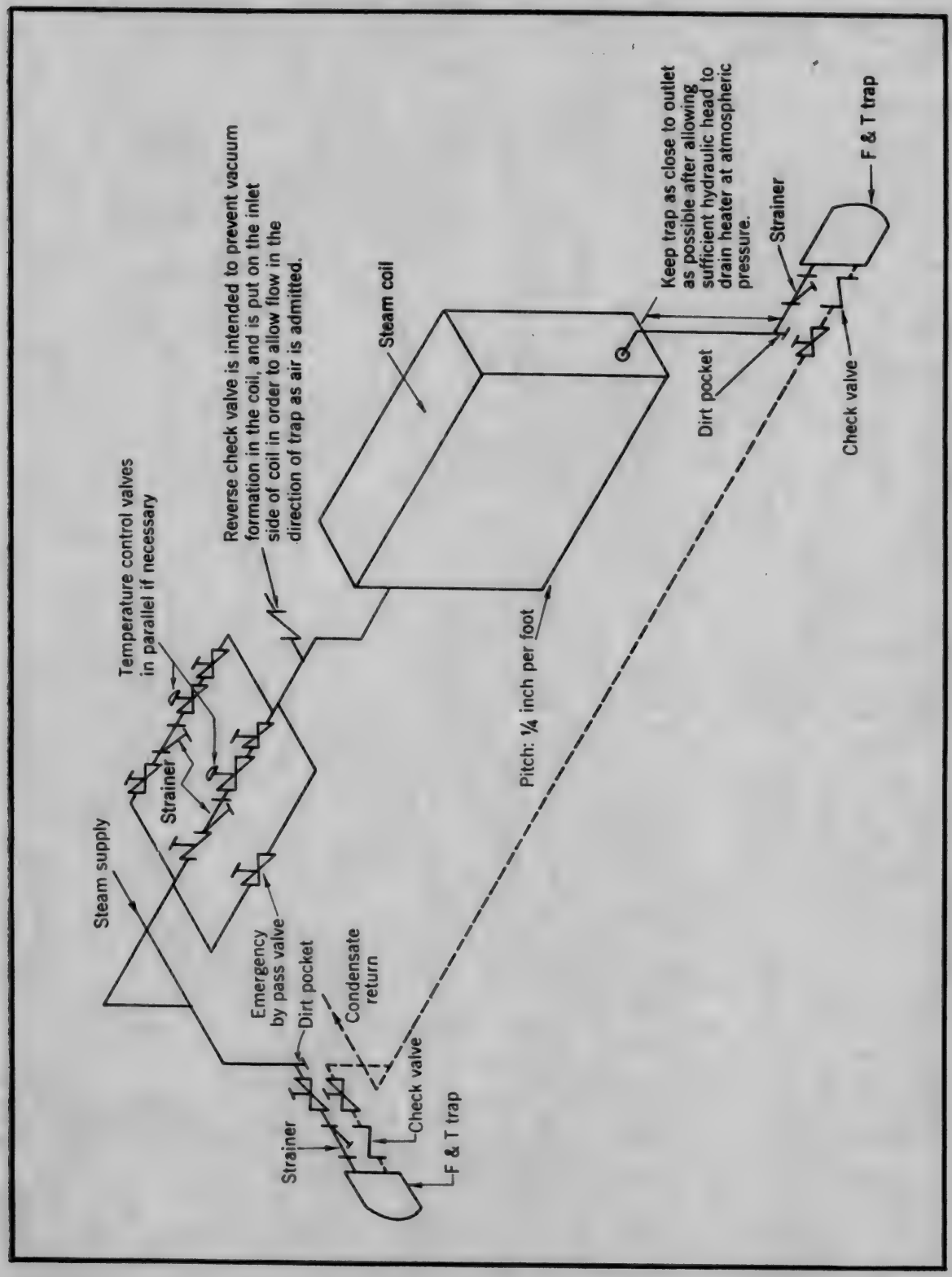
RAINFALL INTENSITY-DURATION-FREQUENCY CURVES



(Continued next month)

PIPING DIAGRAMS FOR STEAM COIL INSTALLATIONS

Hookup for a Single Steam Coil

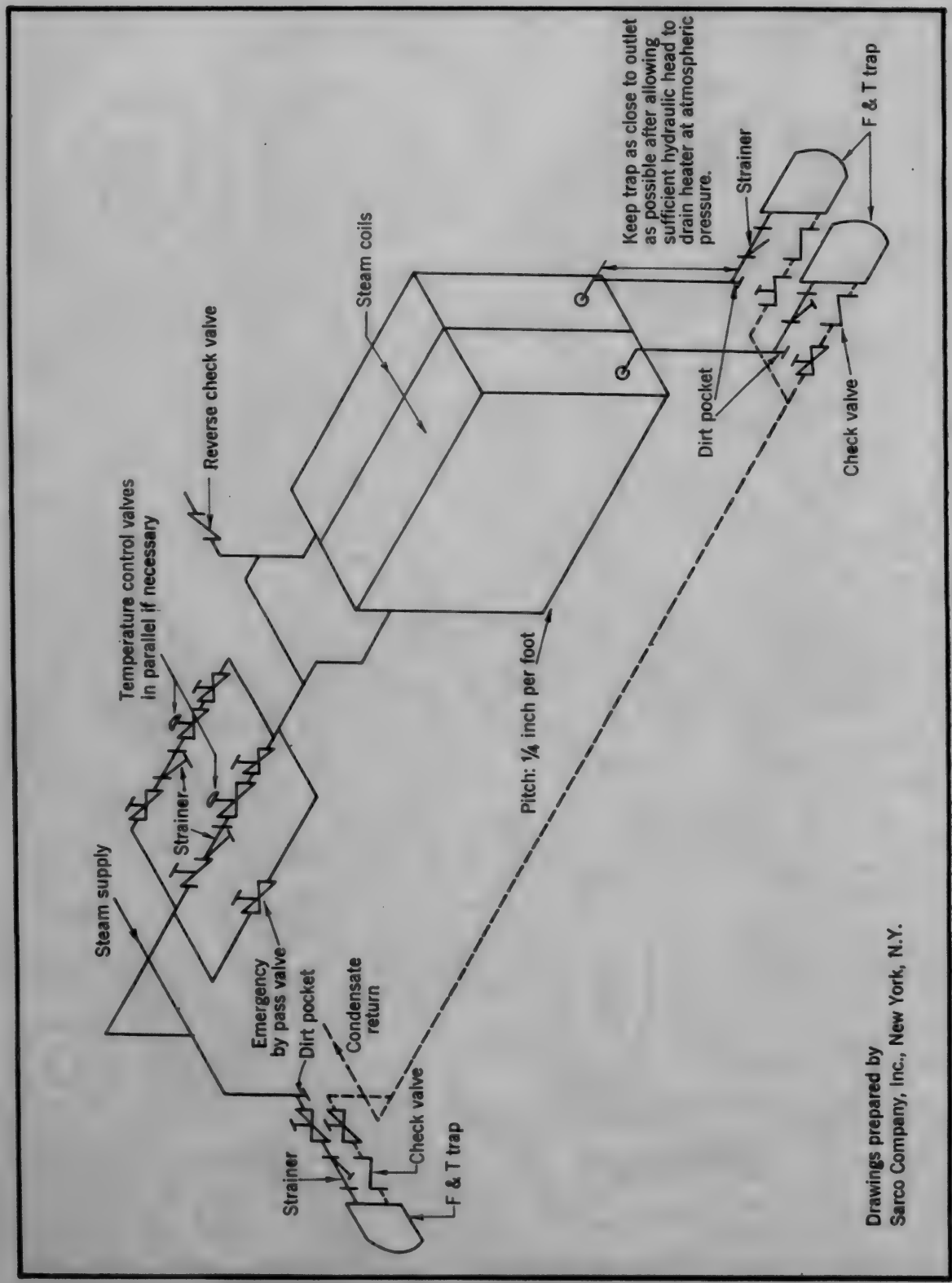

Reverse check valve is intended to prevent vacuum formation in the coil, and is put on the inlet side of coil in order to allow flow in the direction of trap as air is admitted.
Steam coil
Keep trap as close to outlet as possible after allowing sufficient hydraulic head to drain heater at atmospheric pressure.
Strainer
F & T trap
Dirt pocket
Check valve
Temperature control valves in parallel if necessary
Strainer
Steam supply
Pitch: ¼ inch per foot
Emergency by pass valve
Dirt pocket
Condensate return
Check valve
Strainer
F & T trap

DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

July, 1961

PIPING DIAGRAMS FOR STEAM COIL INSTALLATIONS

Hookup for a Double Steam Coil



DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

July, 1961

New light thrown on the

VENT-TO-INTAKE SHORT CIRCUIT

A paper presented last month at the 54th Annual Meeting of the Air Pollution Control Association shows why ventilation make-up air drawn from outside a building may have a higher level of contamination than some of the interior areas which it serves. This helps to explain many of the cases where contaminated air expelled from a building through a vent finds it way back into the building through intake openings. Common examples of such occurrences are incinerator and furnace effluents from apartment houses and industrial process and laboratory fume hood exhausts.

Diffusion of Vented Gas Around Buildings, a paper by James Halitsky, research scientist, N.Y.U. College of Engineering, Research Division, New York City, describes how gas released at one point on the roof of a building may spread over the entire roof. It emphasizes the fact that mere release of gas to the atmosphere does not insure its immediate dissipation. Of cardinal importance is the local wind condition at the point of release. Gases from tall stacks usually are released into a smoothly-flowing wind stream and do not return to the vicinity of the building. Vents or short stacks, however, are usually located in a region of highly turbulent air around the building, called the wake. Gases from these sources dissipate more slowly and come in contact with the building surfaces because air velocities in the wake are low and erratic. When an intake is located in an area of high gas concentration in the wake, it becomes a contamination source for the entire building.

Wind Tunnel Tests Help

Very little quantitative data are available concerning gas concentrations in building wakes. Wind tunnel tests performed on simple shapes and on an irregularly shaped building model in the N.Y.U. low-speed wind tunnel for air pollution research appear to be the only systematic measurements published or in the process of being published. These tests were supported by the National Institutes of Health, both as a general investigation and as an attempt to remedy an odor recirculation problem at the NIH Clinical Center in Bethesda, Md. (See *Air Conditioning, Heating and Ventilating*, May 1961, p. 8).

Tests Yield General Formula

Results of the Clinical Center test were analyzed in detail to determine whether the test data would yield a general formula which might be useful in estimating concentrations around other buildings. Previous tests had shown that concentration patterns are very sensitive to wind direction, building shape, and effluent source location. Thus, it was not expected that exact patterns could be predicted. However, it was felt that even a rough approximation would be an advance in the current state of knowledge and such a formula was deduced from the data. The suggested formula is:

$$D = [4.66 + 0.147\,(L^2/A_e)^{1/2}]^2\,[V/V_e]$$

where D = dilution, defined as the ratio of gas concentration at any point near the building to the gas concentration at the exhaust opening $= C/C_e$,
L = shortest air distance between exhaust opening and any point,
A_e = area of exhaust opening,
V = wind speed, and
V_e = exhaust speed.

D is a dimensionless quantity. Any consistent units may be used for the other terms.

This expression was derived from theoretical considerations of gas diffusion in the atmosphere and uses constants based on test data. The test was performed by releasing a known quantity of gas at an exhaust vent and measuring the resulting gas concentration at each of the air intakes on seven of the nine wings of the building in eight wind directions. The test was repeated for seven exhaust vents. It was found that for each exhaust-intake combination, one wind direction was critical in that it produced minimum dilution. This direction was not the same for each combination. The 49 dilution minimae were then plotted on a graph having dilution as ordinate and distance as abscissa. All test points fell between two curves, one defined by the above equation and the other having dilutions 50 times as large. Thus, the equation is believed to be conservative, since in no case was a test dilution smaller than that predicted by the equation.

Tunnel Results Conservative?

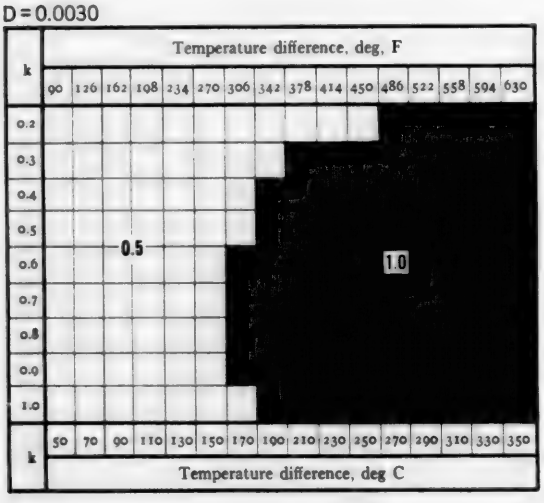
The author cautions that experimental correlations between tunnel and full scale results, other than in a qualitative sense, are lacking. Meteorologists concerned with gas diffusion in the atmosphere are aware that atmospheric turbulence, a significant factor in diffusion, is different in the tunnel and the open air. The effect of turbulence in the free atmosphere on diffusion close to a building is as yet unexplored. The author suspects that a more turbulent wind stream will cause greater dilution close to a building and thus make the tunnel results even more conservative.

How Much INSULATION for Pipes and Flat Surfaces?

Herein is continued Table 2 for determining economic thickness of pipe insulation. The table was begun in the May Reference Section and continued last month for pipe sizes from three-quarters to one and one-half inches diameter. Data are from "Manual on Economic Thickness of Insulation for Flat Surfaces and Pipes", developed by West Virginia University and Union Carbide Chemicals Company. Only those portions of the Manual most useful to ACH&V readers have been reproduced. The whole Manual will be available in an edition published by National Insulation Manufacturers Association, New York.

Table 2. Economic Thickness. 2" Pipe
(**D** from Fig. 1; **k** from Fig. 2; read thickness in inches.)

D = 0.0030



D = 0.0035

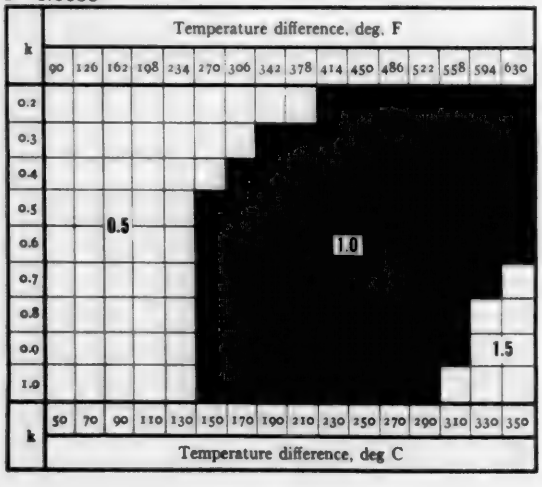
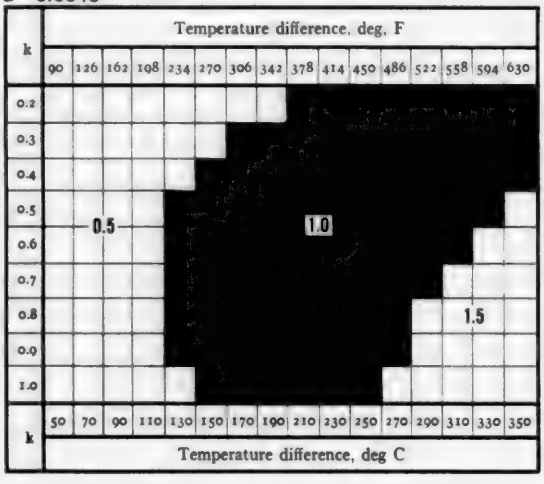
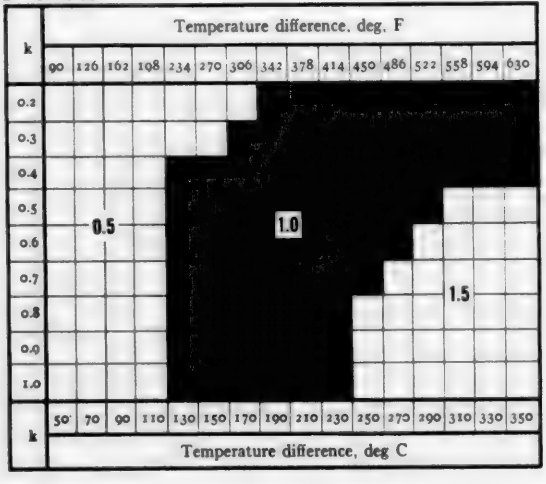


Table 2. Economic Thickness. 2" Pipe
(**D** from Fig. 1; **k** from Fig. 2; read thickness in inches.)

D = 0.0040



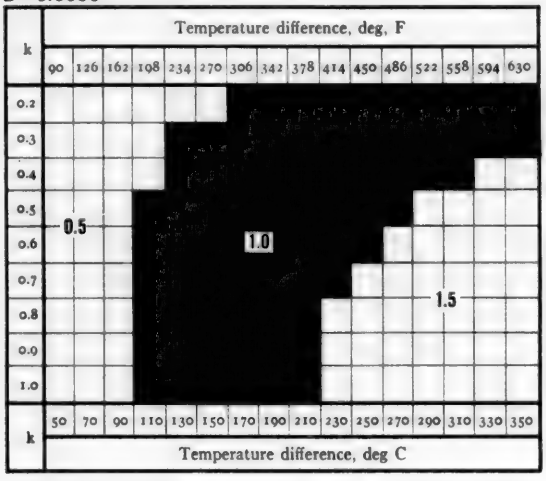
D = 0.0045



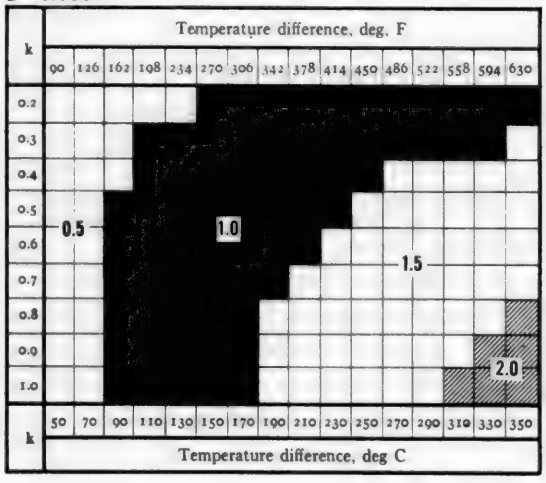
References to Illustrations are to the May Reference Section, starting on page 65

Table 2. Economic Thickness. 2" Pipe
(**D** from Fig. 1; **k** from Fig. 2; read thickness in inches.)

D = 0.0050



D = 0.0060



D = 0.0070

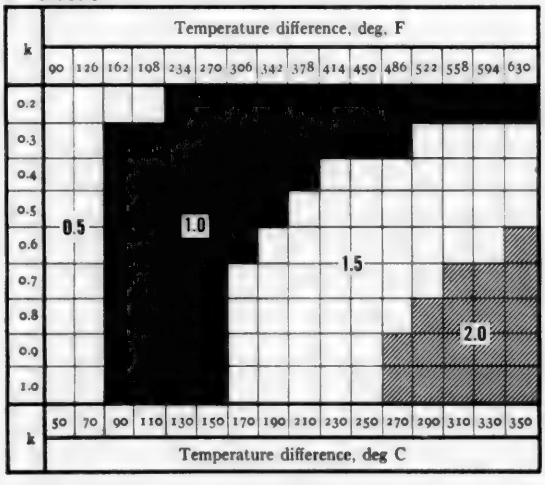
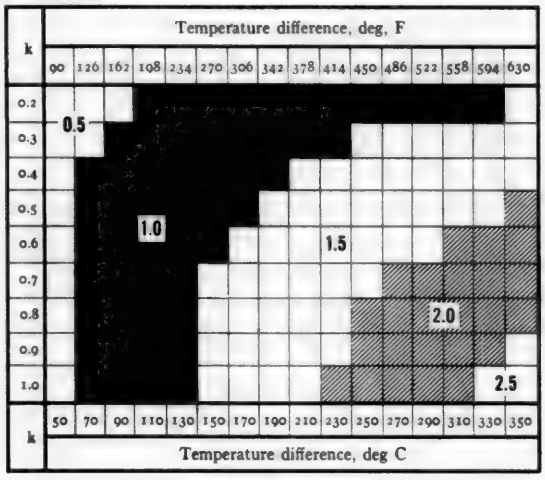
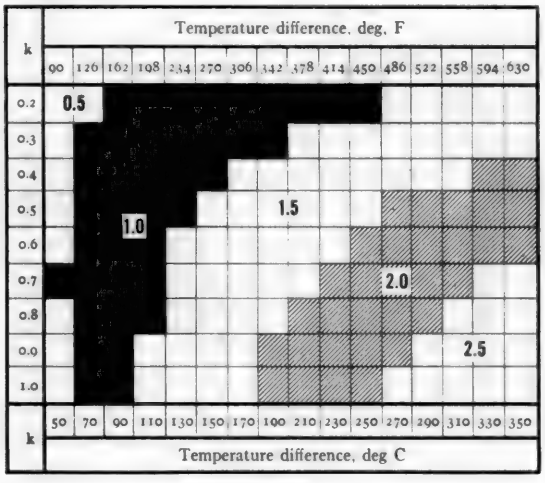


Table 2. Economic Thickness. 2" Pipe
(**D** from Fig. 1; **k** from Fig. 2; read thickness in inches.)

D = 0.0080



D = 0.0100



D = 0.0120

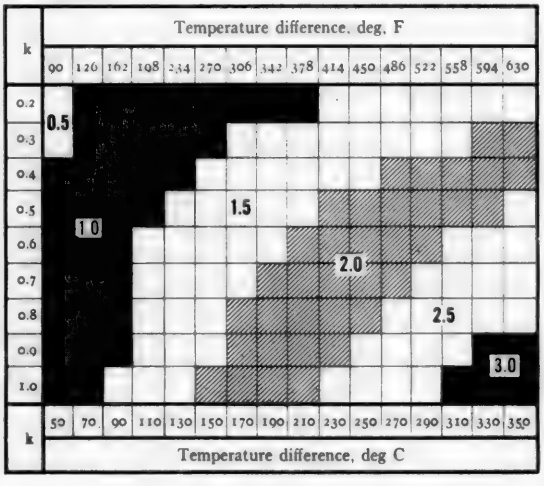
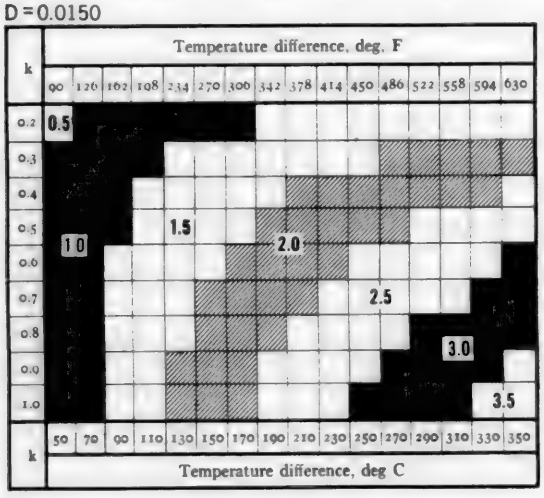
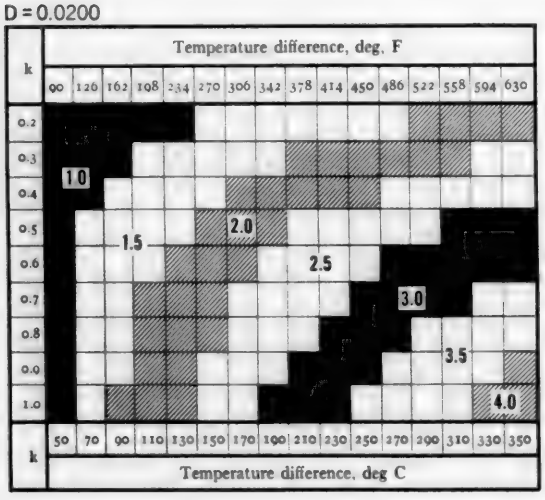


Table 2. Economic Thickness. 2" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

D = 0.0150



D = 0.0200



D = 0.0300

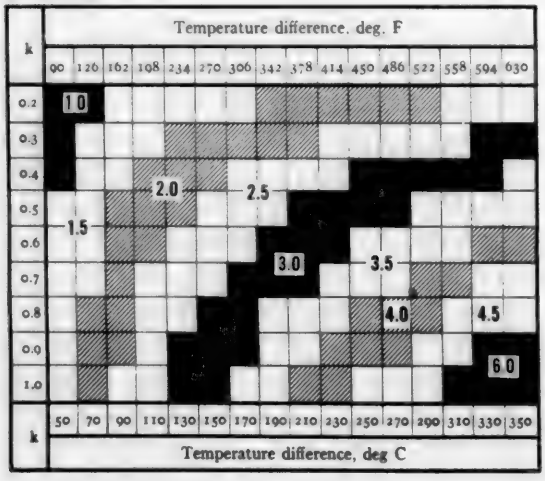
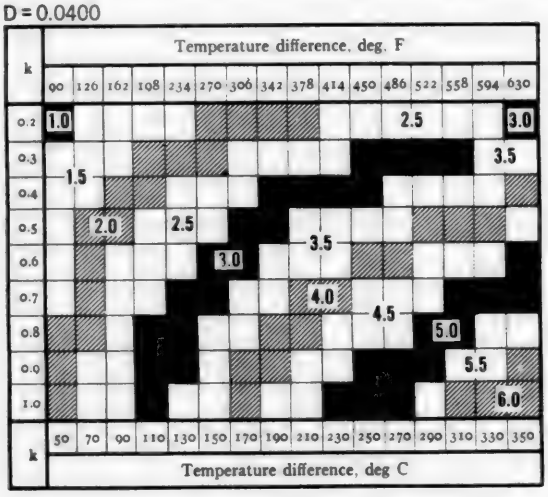
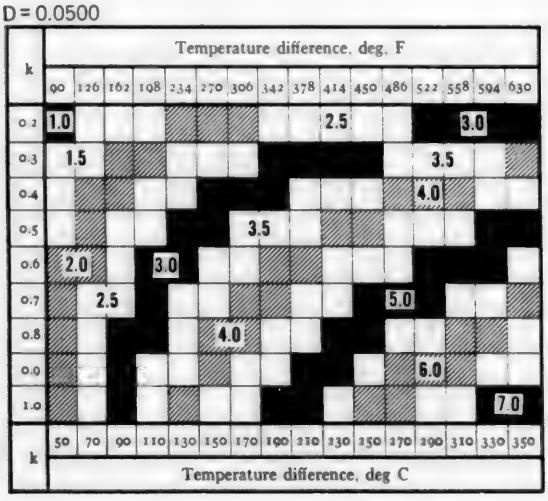


Table 2. Economic Thickness. 2" Pipe
(D from Fig. 1; k from Fig. 2; read thickness in inches.)

D = 0.0400



D = 0.0500



ERRATUM

Capital investment charts for F = $2, $4, and $6 that appeared in the May issue, pages 71, 72, and 73 are not entirely correct. The charts following have been corrected. Also, the scale at the top is expanded.

Substitute this page for page 71 of the May issue.

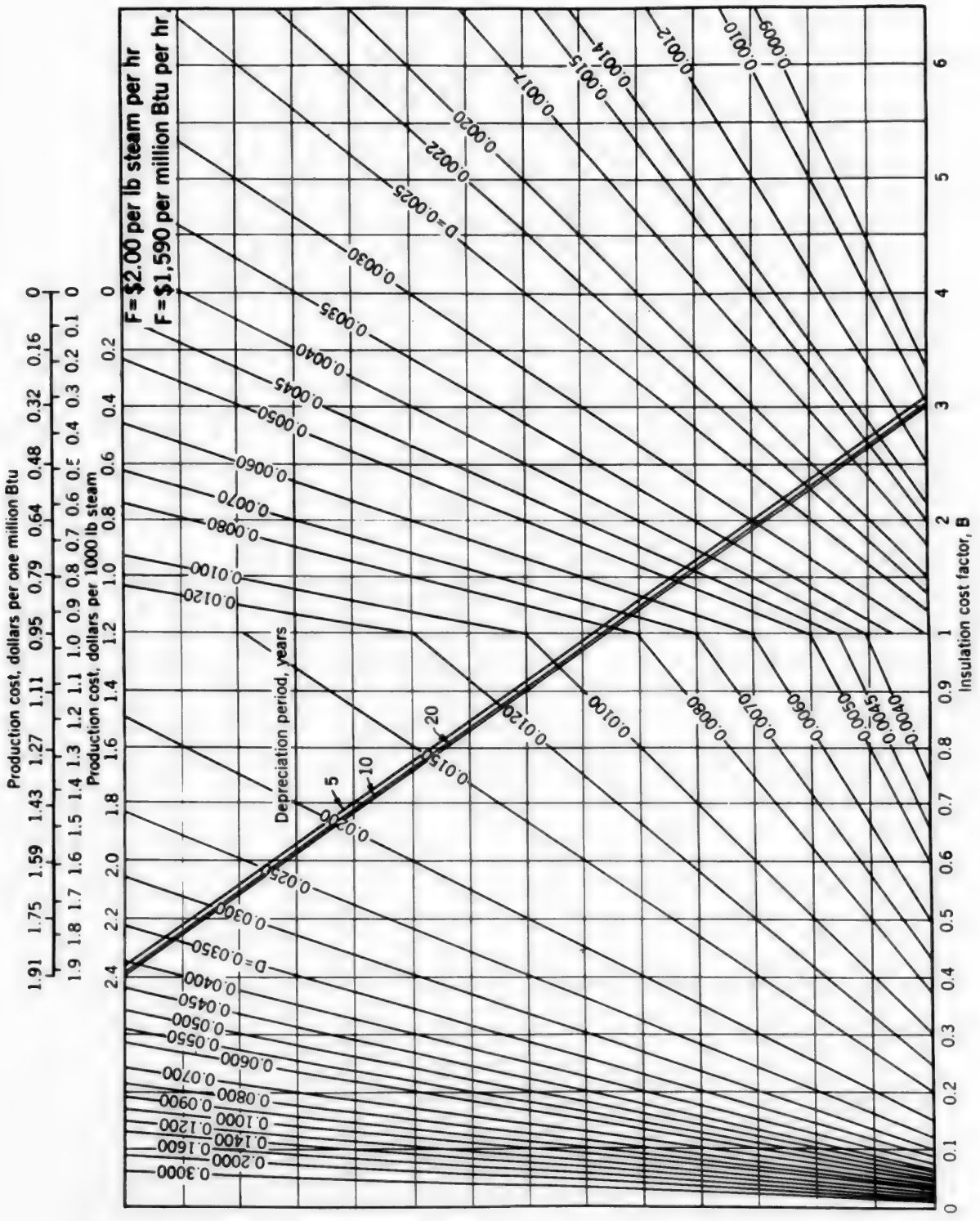

F = $2.00 per lb steam per hr
F = $1,590 per million Btu per hr
Production cost, dollars per one million Btu
Production cost, dollars per 1000 lb steam
Depreciation period, years
Insulation cost factor, B
D = 0.0025
D = 0.0350
5
10
20

Fig. 1-1. Capital Investment Chart, F = $2.

Enter at top of chart at suitable production cost, S', either in dollars per million Btu or dollars per 1000 lb steam, proceed down to appropriate depreciation-period line, then left or right to B value from Table 1. Find D value (radial line) nearest, for use in Table 2.

Substitute this page for page 72 of the May issue.

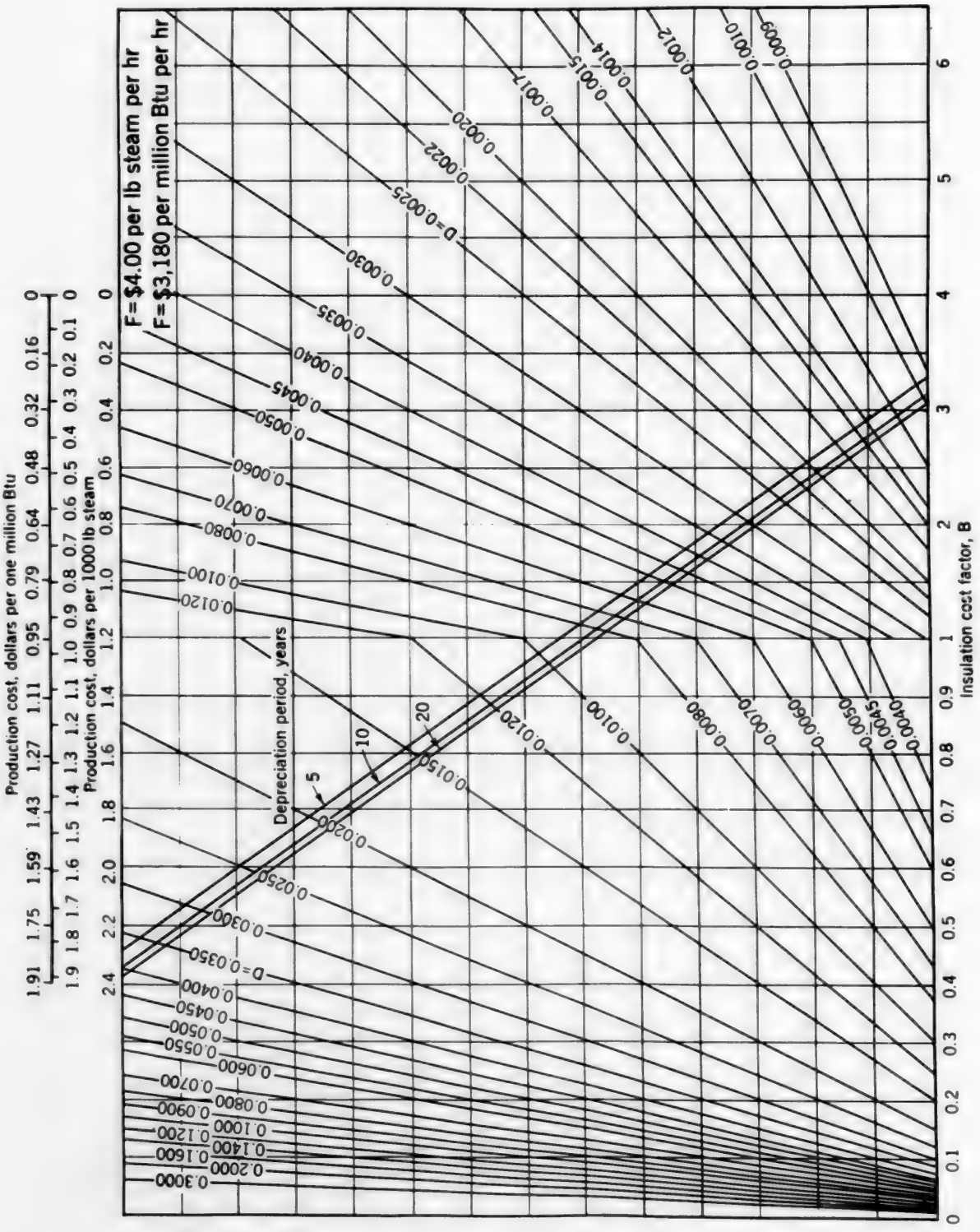


Fig. 1-2. Capital Investment Chart, F = $4.

Enter at top of chart at suitable production cost, S', either in dollars per million Btu or dollars per 1000 lb steam, proceed down to appropriate depreciation-period line, then left or right to B value from Table 1. Find D value (radial line) nearest, for use in Table 2.

Substitute this page for page 73 of the May issue.

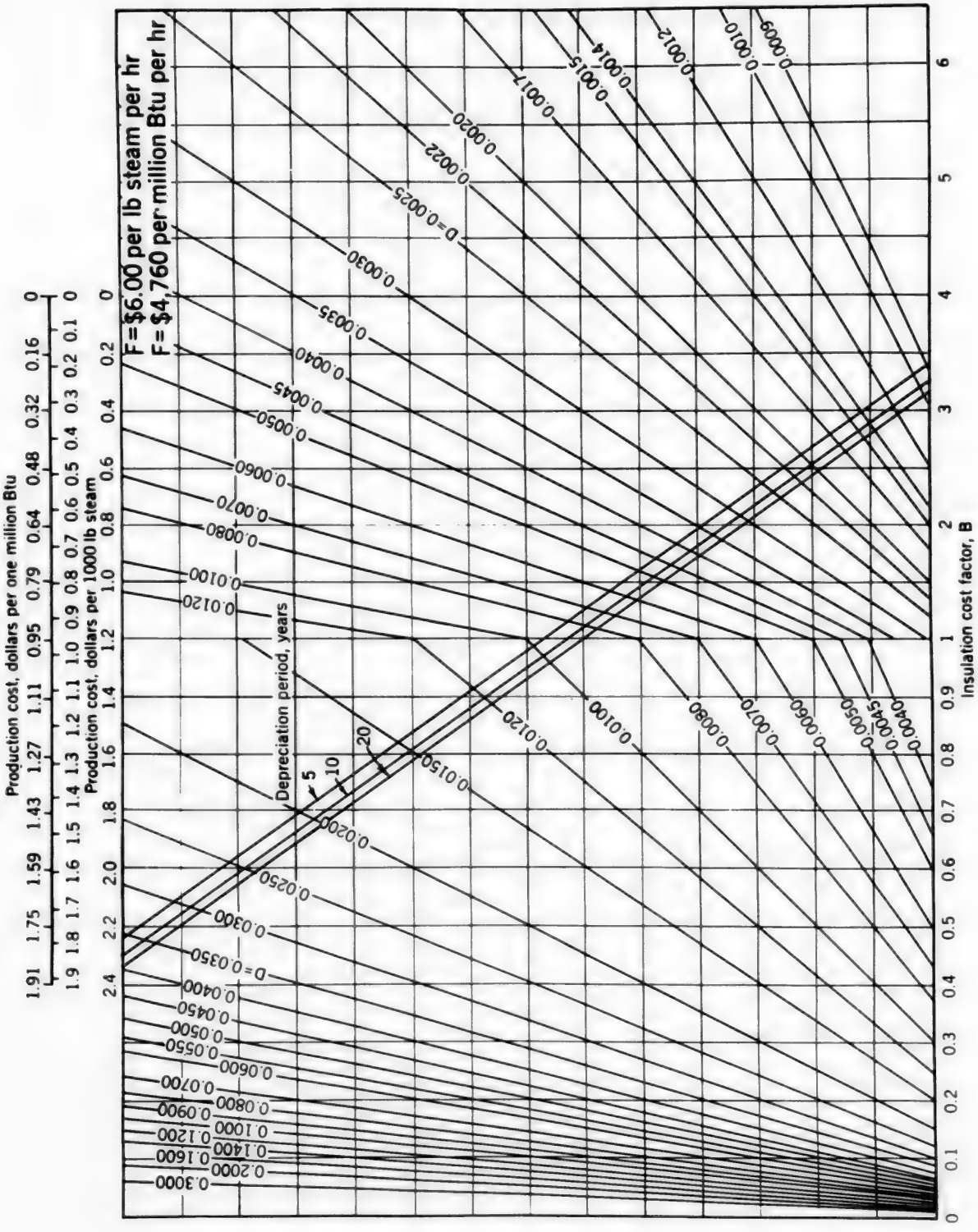

F = $6.00 per lb steam per hr
F = $4,760 per million Btu per hr
Production cost, dollars per one million Btu
Production cost, dollars per 1000 lb steam
Depreciation period, years
Insulation cost factor, B
D = 0.0025
D = 0.0350
5
10
20

Fig. 1-3. Capital Investment Chart, F = $6.

Enter at top of chart at suitable production cost, S', either in dollars per million Btu or dollars per 1000 lb steam, proceed down to appropriate depreciation-period line, then left or right to B value from Table 1. Find D value (radial line) nearest, for use in Table 2.

Louis Blendermann on PLUMBING and PIPING

Vacuum Breakers at Equipment and Apparatus

THE previous article covered the manner in which the water supply to plumbing fixtures is protected by air gaps or vacuum breakers. This article is devoted to the protective measures which must be followed to safeguard water supply lines serving equipment and apparatus, as may be installed in the various types of buildings. Protection of the water supply serving equipment and apparatus is of tremendous importance since this supply is often connected directly to equipment and apparatus which may contain solutions extremely hazardous for human consumption, should these solutions enter the water distribution system.

Therefore, whenever the water is served to equipment and apparatus which contains contaminating solutions, there should be a definite space or air gap between the water outlet and the flood rim level of the equipment or apparatus served. When the water supply is directly connected to the equipment or apparatus, it should always be equipped with a vacuum breaker.

Backflow

As explained in the previous article, when a drop in pressure occurs, backflow will result; when this develops, siphonic actions will draw out the liquid content of equipment to which the water supply is connected.

Detail *A* of Fig. 1 shows what happens when siphonic action occurs in a tank to which a water supply line is connected. The contents are drawn out and into the water distribution system.

Detail *B* shows a vacuum breaker on the water supply to the tank. When siphonic action takes place, the vacuum breaker closes to the backflow and allows air to enter the inlet portion of the valve. This breaks the vacuum created by siphonic action and safeguards the connected water supply line.

Approved Vacuum Breakers

There are many types of vacuum breakers expressly manufactured to protect the water supply line against the hazards of backflow and contamination. Figure 2 shows the details of one approved type vacuum breaker which has been illustrated here for the purpose of example.

Under flow conditions, the piston of the vacuum breaker rises immediately, sealing the air port under pressure to prevent water leakage. The plunger rises next to form the flow orifice, permitting the water to enter through the inlet, whence it flows up and around the plunger and out through the outlet. The piston and plunger are both up in the operating position.

Under backflow or unbalanced pressure conditions, that is, when the flow on the inlet side of the unit is suddenly cut off and reversed as happens when a partial vacuum develops, the plunger instantly drops to the lower seat sealing the water inlet and acting as a check against backflow from the outlet piping. The piston drops at the same time, admitting air and breaking the effect of the vacuum. With piston and plunger in the down position, back siphonage is impossible.

The small detail of Fig. 2, shows how a strainer is often placed ahead of the vacuum breaker to prevent foreign objects from lodging in the working parts of the vacuum breaker. If the water in a given area is known to contain impurities, it is always good practice to install a strainer on the water service in the building. A check with the local water department can quickly determine the needs.

Typical Vacuum Breaker Installations

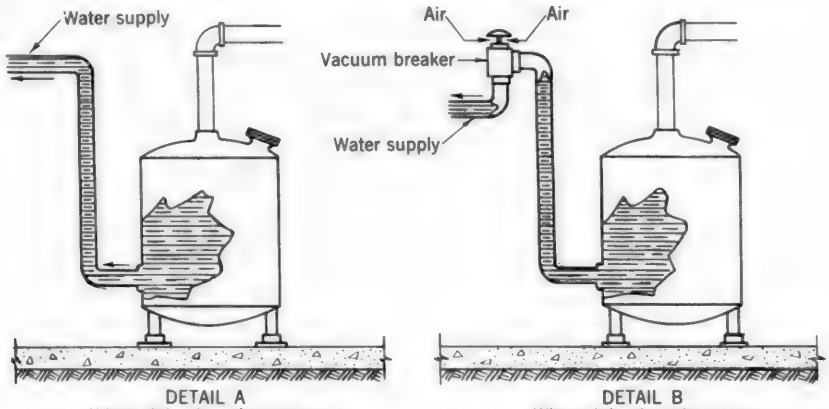
Figure 3 shows several typical applications for vacuum breakers.

Laundry Machines. The cold and hot water supply to laundry machines should be protected against contamination from the wash water contained in the laundry machines. Figure 3 shows one of the several different piping arrangements which may be used to serve the machines. Note the placement of the vacuum breakers.

Tanks. A water supply is needed for many different types of processing and developing tanks. It is always highly recommended that the water supply to such tanks terminate above the tank with a prescribed air gap between the water outlet and the tank. However, this provision is often neglected and the water outlet then terminates below the flood rim level on the tank or is even submerged in the tank. Therefore, it is of utmost importance that the water supply be equipped with an approved type vacuum breaker which is installed in a manner similar to the arrangement shown.

Dishwashers. The water supply to dishwashers are also subject to the hazard of siphonic action due to conditions of backflow. One suggested placement of vacuum breaker is indicated in the detail. However, the engineer should design an arrangement of vacuum breaker and piping that best satifies his specific needs.

Fig. 1. How vacuum breaker safeguards water supply system against siphonic action.


Water supply
DETAIL A
When siphonic action occurs, contents of tank is drawn into water supply line.
Air
Air
Vacuum breaker
Water supply
DETAIL B
When siphonic action occurs, vacuum breaker permits air to enter line thereby breaking the suction of tank contents.

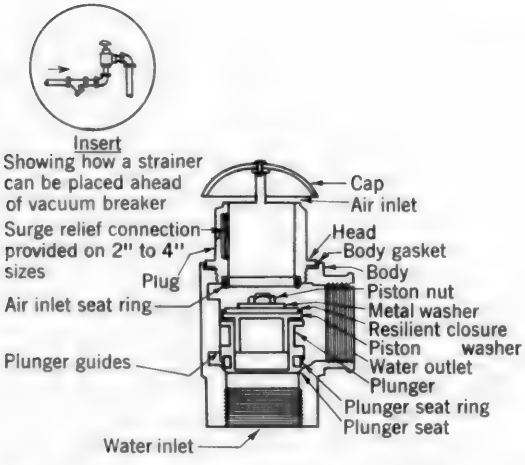


Fig. 2. Operating parts of an approved vacuum breaker.

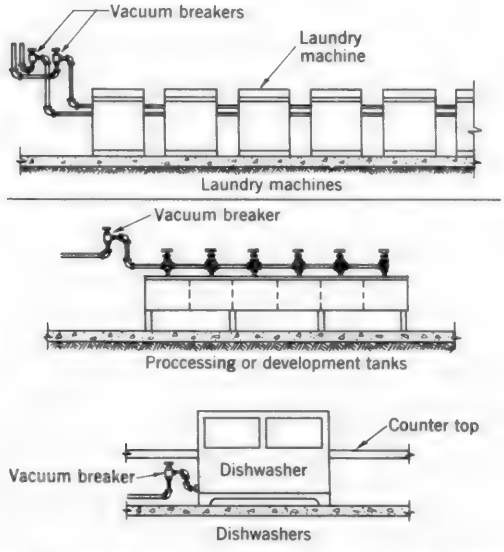


Fig. 3. Installation of vacuum breakers for special equipment.

Other Vacuum Breaker Applications

There are very many needs for vacuum breakers, and the few applications described here are intended only to indicate the varied scope of equipment and apparatus for which they are needed.

Hot Water Generator Equipment. It is important that a vacuum breaker be utilized on the water supply to a hot water storage generator, for two reasons: (1) The vacuum breaker prevents the possibility of drawing the contents of the hot water storage generator into the water distribution system, thereby avoiding the risk of contamination, and (2) the vacuum breaker prevents the possibility of drawing the hot water into the cold water distribution system, where it can create a hazard. In this instance, a person opening a cold water faucet might find that hot water is dispensed rather than cold. This could be serious when high temperature hot water is maintained in the storage generator.

Space Heating Plant. It certainly is not desired to siphon the contents of the space heating plant into the water distribution system. Yet, backflow can cause siphonic action if it occurs at the instant that water is being added to the space heating plant. The water contained in the space heating plant can be quite harmful for human consumption when you consider the various mixtures that are added to the boiler water for sealing leaks or to inhibit the formation of rust scale. A vacuum breaker is of extreme importance in this application.

Lawn Irrigation Supply. The water supply to wall hydrants and lawn irrigation systems should most definately be protected with a vacuum breaker. Take

Fig. 4. Installation of vacuum breakers on cold and hot water lines serving laboratory table.

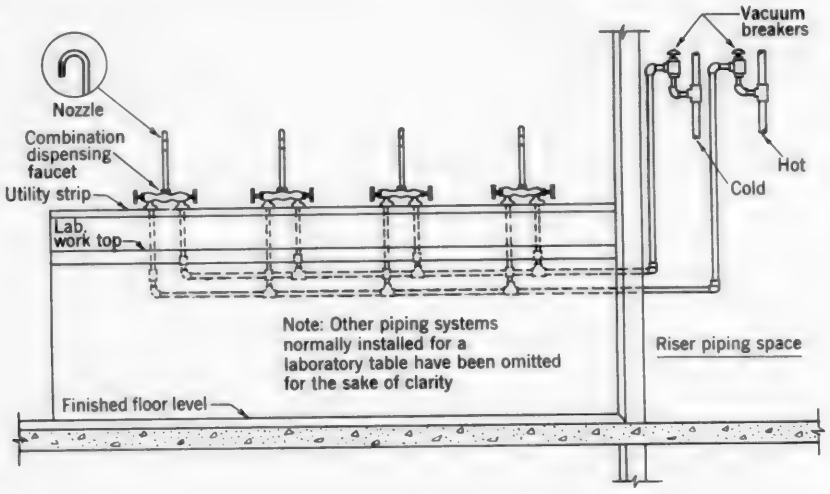
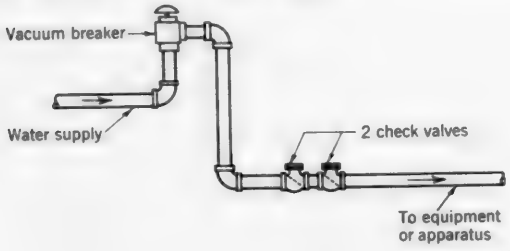


Fig. 5. (below) Added protection is provided by two check valves.



the wall hydrant for example. This hydrant is used for many gardening reasons including the following:

1. A hose from the hydrant is often directly connected to a jar containing a chemical mixture which is sprayed on the grass, shrubs or flowers. Such mixtures can be most harmful when consumed by humans and especially children.
2. The hydrant is often used to provide pressure for paint spray apparatus. It is needless to mention the potential hazard to humans when paint is siphoned into the water distribution system.
3. The lawn irrigation system also presents an extreme hazard. Here again, dangerous mixtures are in solution at the grass surface when the lawn sprinkler system is in operation. The solution is easily siphoned into the water distribution piping when conditions of backflow occur.

An arrangement of laboratory piping and vacuum breakers, shown in Fig. 4 is only for example. Laboratories delve into the realm of the unknown. Therefore there is no limit to the dangerous activity to which the water supply piping will be subjected. It is of vital importance that the water supply piping be safeguarded against the hazard of backflow and its resultant siphonic action.

The combination faucets shown in Fig. 4, are typical of the type used in laboratory research. When used only for dispensing water into an open jar or vessel there is little relative danger involved. However, the nozzles are equipped with serrated tips to permit the use of a hose when certain experiments are performed. Should a condition of backflow occur during one of the experiments, the entire contents of any apparatus to which the hose is connected could easily be siphoned into the water distribution system. Therefore, it is of the utmost importance that the cold and hot water piping be protected by approved type vacuum breakers. These same considerations apply to the varied equipment and apparatus installed in hospitals. With the high degree of sanitary cleanliness maintained in a hospital, the water supply is the only medium that can convey contamination from one area to another unless the proper safeguards in the form of vacuum breakers are applied to the water supply piping.

Care of Vacuum Breaker

The vacuum breaker should always be placed in an exposed location where it can be visually inspected at periodic intervals. If it is concealed, an access door or other means must be provided to facilitate the ease of inspection and replacement. When in time, the vacuum breaker shows indications of failure in function, it should be immediately replaced. This frequent inspection of the vacuum breaker is an important maintenance chore but its fulfillment offers a complete protection against the instantaneous effects of backflow and siphonic action.

Extra Precautionary Measures

Very often, the engineer will indicate the placement of two check valves on a water supply to certain equipment or apparatus. The check valves are in addition to the vacuum breaker. Fig. 5, shows this installation.

The check valves cannot replace the protection of a vacuum breaker but help in the prevention of backflow. Should backflow occur, the flappers in the check valves will close and the vacuum breaker is there to handle any action that manages to pass the check valves.

Pills for Sick Duct Systems

Duct systems often fail when designers overlook the fundamentals. The Clinic diagnoses some sorry cases, then prescribes the remedies.

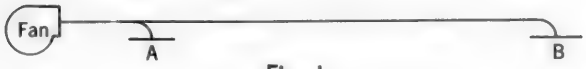


Fig. 1

THE SIMPLE DUCT SYSTEM in Fig. 1 has one outlet near the fan, and an identical one about 50 ft from the fan. Since it is desired that they deliver the same cfm to the same size room, outlet velocities of each must be the same. How does the pressure drop between the fan and outlet *A* compare to that between the fan and outlet *B*?

Engineers, *who ought to know better*, have told me that the pressure loss between the fan and the outlet *B* is greater! Since these are parallel circuits between a common fan and rooms in which the pressures are equal, how can the pressure drop to *A* and *B* be different?

If ductwork is designed on the mistaken assumption that, with equal flows, the loss between the fan and *B* will be greater, when the system is placed in operation, air flow will so proportion itself that the pressure losses through the two circuits are equal. Then *A* will deliver more air than desired; *B*, less. To rectify the error, some restriction, such as a damper, will be put in the circuit to *A* to reduce flow.

Some time ago, I had the problem of correcting the distribution in a system which had been designed on the assumption that the pressure drop to some outlets near the fan would be less than that to the most remote outlet. To get the desired flow from each outlet, it was necessary to impose as much as 0.25 inch of water resistance between the main duct and an outlet near the fan.

Schemes that Won't Work

The main duct was in a furred ceiling, making any access to it impractical. Duct branches to the ducts were not over a foot long, as in Fig. 2. The space was inadequate for a single damper because (1) the damper would have to be nearly closed to lose 0.25 inch and (2) the two streams of air from each side of the damper would have let through only a small part of the grille area instead of over the whole face of the grille, resulting in poor distribution of air to the room. Fig. 3 illustrates what will happen. Note the air *intake* in the center of the grille.

A multi-blade damper, with all blades turning in the same direction, would have sent the air to one side of the grille and have given poor distribution, as shown in Fig. 4. Note the air *intake* at one side. A multi-blade damper, with alternate blades turning in opposite directions, would have been much better but, unless a considerable number of blades were used, the space would still be too small for really even distribution over the face of the grille.

Perforated Board is Excellent Damper

The problem was solved simply and effectively by inserting a piece of ½-inch thick Celotex, into which a number of holes had been drilled, as shown in Fig. 5. The air through each hole reaches a maximum

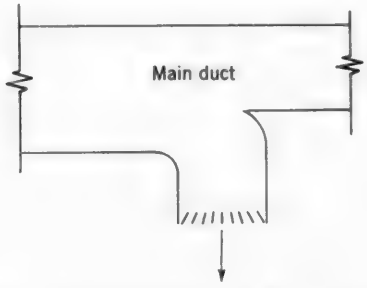


Fig. 2. Duct branch is less than a foot.

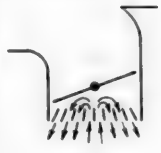


Fig. 3

Fig. 4

Fig. 5

Poor air distribution results when single-blade (upper left) and multi-blade (top right) dampers are used. Solution, left, is piece of Celotex with half-inch holes.

velocity at a vena-contracta which has an area about 0.6 times the cross section of the hole. The pressure loss is somewhat less than the head corresponding to the velocity at the vena-contracta. The value of that head is given by $V = 4005\sqrt{h}$, where V is the velocity in fpm and h is the head, in inches of water. (The constant 4005 applies for standard air, 0.075 pcf.)

To lose 0.25 inch, V must be about 2000 fpm. With 2000 fpm through the vena-contracta, the average velocity through the holes must be about 1200 fpm. Total area of the holes is the cfm for the grille divided by 1200 fpm. The perforated insulating board has the holes close enough to result in even distribution. It imposes the approximate desired resistance and results in extremely little noise.

Air Goes the Wrong Way

Another case in point involves the location of outlets too close to a change in direction, as shown in Fig. 6. The designer intended that air leave the duct at the outlet shown. However, the air attains a higher than average duct velocity as it approaches the outside radius of the elbow. This can result in air entering part or all of the grille instead of leaving it. In a cotton weaving plant, a case like this was clearly indicated by the lint. The outlets delivering air were fairly free of lint. One, in a position similar to that in Fig. 6, was well coated with lint over the whole outside face, showing that air was entering the duct through the grille.

Plenums Often Waste Power

Plenums often cause needless pressure loss. Fig. 7 illustrates a case I recently encountered, with a plenum between a two-fan air conditioner and three ducts, each with a heating coil. (For convenience of discussion, assume the three branches are of equal size and air flow.)

Air velocity leaving the fans is about 1,700 fpm, which corresponds to 0.13 inches SP. The plenum effectively loses this velocity energy and, because of the great turbulence in a plenum arranged in this way, the actual loss will be even greater than the 0.13 inch of velocity pressure.

Transformation from fan outlet to the duct should be made with a gradual change in cross section. In this case, the change should have been a gradual increase in area from the fan outlets to the larger duct cross section, as shown in Fig. 8.

The plenum looks simple and requires less work on the part of the designer, but it is probably not less costly because a plenum, as shown in Fig. 7, requires heavier gage metal and some angles for bracing.

Plenums are not too bad in residential systems using velocities of say 800 fpm (corresponding to 0.04 inch SP) because loss of such a velocity head may not be of much consequence. However, with some higher velocity industrial systems, losses caused by plenums have been costly power losses. The important

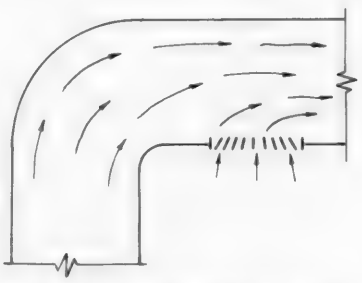


Fig. 6. Outlet too close to elbow.

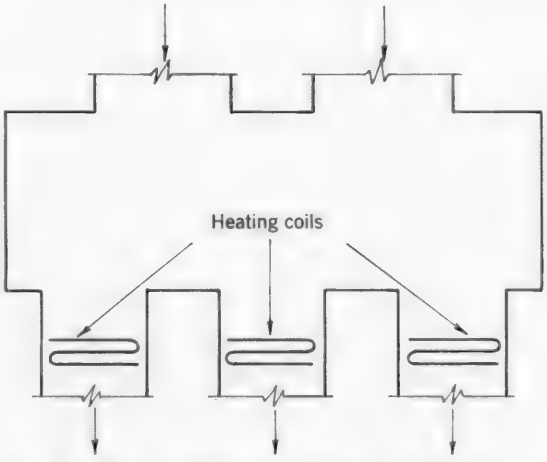


Fig. 7. Plenum, connecting two-fan conditioner and three ducts, causes excessive pressure loss.

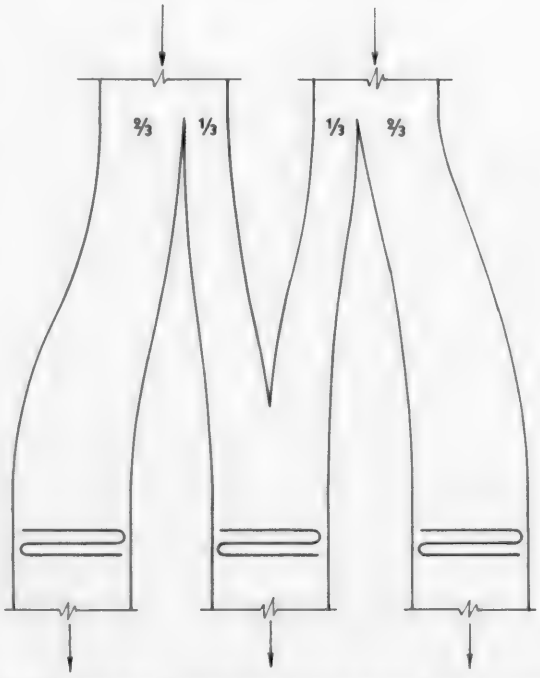


Fig. 8. This is the way the problem in Fig. 7 should have been solved.

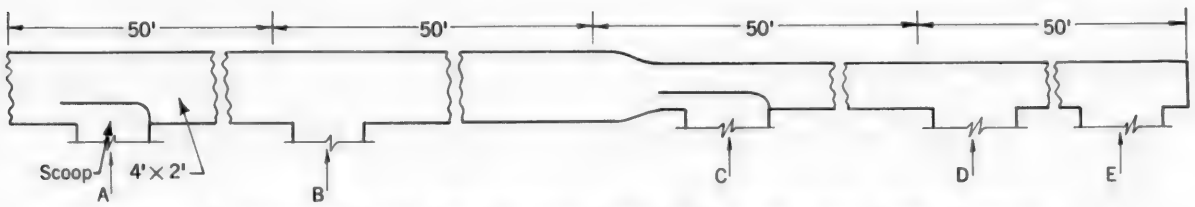


Fig. 9. Two-hundred foot duct delivering air to cold storage room. Scoop is needed at *A* to create sufficient static pressure. At *B*, static pressure is sufficient. At *C*, after reducer, a scoop is again needed to convert velocity pressure to static pressure.

thing is to realize that a plenum results in a loss of energy and should be used only if its simplicity compensates for the loss.

Scoops Permit Smaller Ducts

The design of ducts can often result in lower cost as well as better air flow if full advantage is taken of the possibility of changing velocity pressure to static pressure and vice-versa. For example, take the case of an air handling unit that delivers 26,000 cfm to a duct (Fig. 9) running 200 ft in a cold storage room. The unit has two fans (each 13,000 cfm) and stands on the floor, discharging vertically. Fan outlet velocity is 1800 fpm. Two ducts, one from each fan, rise with gradually decreasing cross section as they join into one duct which has reduced to 4 ft x 2 ft by the time it reaches the 27-ft ceiling. The duct continues down the ceiling for 100 ft with 4 ft x 2 ft size and then reduces to 3 ft x 2 ft for the last 100 ft.

The velocity in the 4 ft x 2 ft duct at the start is about 3200 fpm, corresponding to 0.64 inch pressure, about 0.44 inch more than the 0.2 inch which corresponds to the 1800 fpm fan outlet velocity. This results in a static pressure at the fan outlets of about 0.5 inch greater than in the duct as it starts across the room. However, the pressure at the beginning of the horizontal run of the 4 ft x 2 ft duct is about the same as the room (which we will call zero) so that the static pressure at the fan outlets is about 0.5 inch which is not excessive for a 200 ft distribution system.

The 4 ft x 2 ft duct runs about 100 ft, then changes to 3 ft x 2 ft for the last 100 ft, as shown in Fig. 9. Actually there are outlets on both sides of the duct but, for convenience the illustration shows only those on one side.

With no static pressure at Outlet *A*, a scoop is required to convert velocity pressure to static pressure. The cross section the scoop offers to the air stream is the same proportion of the whole-duct cross section, as the air flow from Outlet *A* is to the total air flow at that point. As the air moves along the duct, the cfm decreases and since the duct size remains the same, the velocity decreases. As the velocity drops, a part (approximately 60% to 75% in cases of this type) of the energy becomes static pressure and this static pressure increase exceeds the friction loss. This results in a higher static pressure in the duct at points farther along in the direction of air flow.

At a point about 50 ft from the inlet, as indicated in Fig. 9, the static pressure is enough above the room pressure to cause the air to leave the outlet at the proper velocity and no more scoops are necessary. After 50 ft more, the size is decreased, increasing velocity and decreasing static pressure. Therefore scoops are used back of outlets for about the next 50 ft to the point where the static pressure has again increased to a value such that they are unnecessary.

The use of this design results in smaller duct at the beginning and less size changes. In many cases, if the duct is not too long, there may be no size changes at all. In some cases the static pressure changes very little for a good part or all of the duct length, as it does between about 50 ft and 100 ft and the length from 150 ft to 200 ft of the duct shown in Fig. 9.

In a certain textile plant, the distribution of 228,000 cfm to a room about 250 ft x 160 ft is taken care of by a 6⅔ ft x 10 ft duct 250 ft long, running down the center of the 160 ft width. There are outlets on each side. The pressure in the duct at the beginning is less than the room pressure, but the reducing velocity results in a static pressure above the room for the last ½ to ⅔ of the length. Scoops are, of course, used until the static pressure reaches about ⅛ inch, which is necessary for discharge from the grilles at the required velocity.

In the cases mentioned, the air was all delivered to a single room so that a variation of 5 or 10% above or below that desired from any outlet, would not appreciably affect the temperature or humidity in any part of the room. Since care was taken in the design, no dampers were installed in the duct in either case. Experience showed that dampers were not required. Had the outlets discharged to rooms where more precise distribution might be necessary or where it might not be possible to predict in advance the exact relative air rates, dampers probably would have been desirable for initial adjustment or later changes in adjustment to compensate for changed conditions.

When designing ductwork (or anything else) careful consideration of the laws of nature which apply and less tendency to merely follow what has become common practice, can often result in better operation and sometimes less costly construction. A little more time spent with the design will usually eliminate alterations after installation. It's so much easier to change lines on paper than to alter ductwork or piping on the job.

Formaldehyde Exposure from Paper Process Solved By Air Sampling and Current Studies

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Fig. 1. General view of paper conditioning booth. Workers are in positions originally established for this operation, and these positions were later changed.

THE U. S. ARMY MAP SERVICE, FAR EAST, located in Tokyo, Japan, installed a paper conditioning process in early 1959. Shortly after the process was placed in operation, the workers complained of itching eyes, dry and sore throats, disturbed sleep, and unusual thirst upon awakening in the mornings.

Paper Conditioning Process

The wood pulp paper used at this installation for map making had prior treatment with urea-formaldehyde or melamine-formaldehyde resin for shrinkage control. However, before the paper could be utilized satisfactorily, additional treatment for shrinkage control was necessary.

The additional conditioning process subjected the paper to certain controlled temperatures and humidities. The conditioner consisted of a large booth whose inside measurements were about 42 ft by 9 ft by 6.25 ft high. There were two openings at one end, one for the receipt and the other for the removal of the paper (See Fig. 1). Batches of the paper were placed on bar hangers on a slow moving continuous roller chain conveyor. The time for a complete conditioning cycle was about 45 minutes (two passes through the conditioner).

There were three separate conditioning units installed outside the process booth to maintain the prescribed temperatures and humidities. One steam heating unit supplied hot, moist air to the left section of the booth. The other two units, a steam heater and an air conditioner, were used to maintain required summer and winter temperatures and relative humidities in the right section. The following table shows the temperatures and humidities which were to be maintained during summer and winter periods in each section of the process booth.

TEMPERATURES AND HUMIDITIES TO BE MAINTAINED

Booth Area	Summer Periods		Winter Periods	
	Temperature, Deg F	Relative Humidity	Temperature, Deg F	Relative Humidity
Left section	104	90%	95	90%
Right Section	104	30%	95	90%

*The author is presently employed with the U.S. Public Health Service at the Occupational Health Research and Training Facility, Cincinnati, Ohio. Mr. Morrill has a B.S. in Civil (Sanitary) Engineering, and a M.P.H. in Industrial Hygiene Engineering. He is a registered professional engineer in the States of Utah and Arizona, and is a member of American Conference of Governmental Industrial Hygienists and American Industrial Hygiene Association.

Fig. 2. View into left section of paper conditioning booth. Note multiple nozzles for conditioned air inlet on side and at bottom. Both photos, courtesy U.S. Army Mapping Service.

The conditioned air entered the respective sections of the both through multiple nozzles positioned on the side (about midway) and on the bottom (as shown in Fig. 2), was returned to the respective conditioning units via overhead exhaust ducts and then recirculated.

This operation required two workers. One worker stood partly inside the booth at the front (Fig. 1), while the other worker was outside at the periphery of the booth.

Air Sampling

In view of the symptoms experienced by the workers and the fact that the paper had been treated with a formaldehyde resin, air samples were collected in the breathing zone of the workers primarily for formaldehyde but also for ammonia. The chemical analyses revealed concentrations from 0.9 to 1.6 parts of formaldehyde per million parts of air. The analyses, performed by personnel of the Department of Chemistry, 406th Medical General Laboratory, U. S. Army, also indicated a trace of ammonia.

Air Currents Study

By use of a velometer and by smoke tube tests it was realized that air outside the booth was drawn into the lower half of the opening on the right side of the booth, and the contaminated air spilled outside the booth from the upper half of this opening. The paper as it traveled through the conditioning booth forced some air ahead similar to a piston action. This factor, combined with the merging of the horizontal and upward air streams inside the conditioning booth from the multiple nozzles, made the booth's ventilation design characteristics critical. The return air capacity of the system and the location of the exhaust openings should have been designed to eliminate or reduce to an extremely low quantity the spillage of contaminated air into the breathing zone of the workers.

Conclusions

The air sampling results clearly indicated that the workers were exposed to low concentrations of formaldehyde—lower than the threshold limit value of 5 ppm[1] and not enough to cause illness. However, it was sufficient to be intensely irritating, causing the symptoms experienced by the workers. The formaldehyde concentrations found and the symptoms experienced by the workers were similar to those experienced by employees in a dress shop from garments which had been treated with urea-formaldehyde resin for wrinkle resistance and shrinkage control, as reported by the Ohio Department of Health.[2]

It was recommended that the ventilating system for the right side of the booth be so modified as to have this side of the booth under negative pressure, in order to overcome air spillage at the right front. Therefore, it was suggested that the exhaust capacity be increased and the direction of air currents inside the paper conditioner be altered to permit a more direct exhaust of air, keeping flow away from the right frontal area, particularly for the upper half of the opening.

It was further recommended that the position of the workers be changed to the left side of the booth at a place just in front of where the semi-conditioned paper would re-enter the conditioner.

References

1. "Threshold Limit Values for 1959, adopted at the 21st Annual Meeting, American Conferences of Governmental Industrial Hygienists, Chicago, April 1959". *A.M.A. Archives Industrial Health*, 20:266-270, Sept. 59.
2. Bourne, H. G., Jr., and Seferian, S., "Formaldehyde in Wrinkle-Proof Apparel Produces . . . Tears for Milady," *Industrial Medicine and Surgery*, 28:232-233, May 59.

Boiler Technique Cuts Cost Of Dormitory Expansion

Job-Built boilers have individual sections constructed at the factory, and are transported in sections . . .

. . . designed to be moved into existing boiler rooms through available doors and passages with minimum or no alteration. After . . .

. . . component parts are assembled and tacked, welding is completed. Tubes, smokeboxes and . . .

MANY BUILDINGS ARE DESIGNED AND CONSTRUCTED with future expansion in mind. In such cases, it is generally economical to have service buildings originally designed to accommodate additional equipment at the time of expansion. It is not always possible, however, to predict the extent of expansion with complete accuracy. As a result, building modifications and additional facilities can run into considerable expense unless unusual short cuts are devised. The Job-Built technique, offered by American-Standard Industrial Div., Detroit, Mich., is one of the more important short cuts available today.

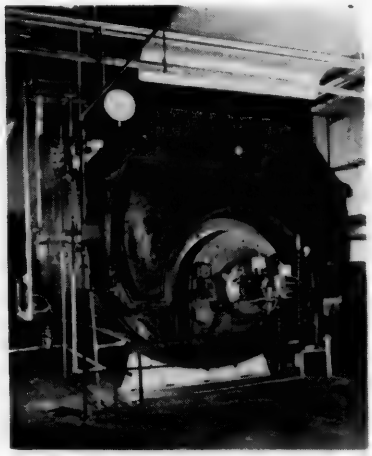
Until recently, this boiler technique was applied in isolated cases to solve individual problems rather than as a concept in the boiler industry. But with today's vigorous expansion in schools, hospitals and industry gaining increased momentum, this concept of boiler installation promises to play an increasingly important role in reducing service facility costs by substantial margins. This is particularly true in the face of the continued rise in construction costs which can easily become excessively disproportionate in overall service facilities expansion.

A typical example of a service facility expansion where the Job-Built concept was applied occurred with Radcliffe College dormitory. When the dormitory was originally constructed, two boilers were installed. Projected plans for expansion at that time called for one more boiler like each of the first two. Provisions were made so that the new boiler could be easily put into place.

When the time for the expansion of the dormitory came, it was greater than expected because of the swelling college enrollments similar to those being experienced throughout the nation today. The new service facility requirements called for a boiler considerably larger than either of the other two to accommodate the considerably greater number of students than had been expected.

A conventional boiler installation would have required major exterior building alterations and construction to move the new boiler in. Also, interior walls and pillars would have to be removed and later replaced. A conference with contractors revealed that building construction costs alone would be approximately $5000 to remove and replace enough existing construction to install a fully assembled boiler. By comparison it was found that a Job-Built installation would reduce these construction costs by 60%.

Component parts of a Kewanee Job-Built boiler for the Radcliffe dormitory were small enough so



. . . other boiler parts are then installed. When fully assembled, boiler receives a hydrostatic test far in excess of actual working pressures to assure a safe, dependable unit.

that none of the walls or pillars had to be removed or altered in order to get the pieces into the boiler room. When fully assembled, the new boiler measured approximately 8½ feet in diameter and 19 feet, 8 inches long, considerably larger than the opening through which the components passed.

Once the boiler segments were in the boiler room, local qualified boilermakers were called in to weld the boiler strictly in accordance with American-Standard Industrial Division quality control procedures and in compliance with the ASME Code. Before shipment to Radcliffe, a boiler inspection and insurance company fully inspected each of the components at the factory. Their inspection papers, instead of being completed at the Kewanee plant, were sent to a local office of the insurance company near Radcliffe College. Personnel from this office performed regular inspections of the methods and workmanship at the jobsite in order to meet all state, municipal and insurance company regulations.

Upon completion of the job, the insurance company stamped the boiler and Radcliffe College was in possession of a boiler of standard design and dimensions, built in compliance with every requirement of the ASME Code and rated in accordance with the Steel Boiler Institute. The entire job was completed in ten days.

Trends in Greenhouse Conditioning

CAREFUL CONTROL OF HEAT AND HUMIDITY is important in any greenhouse; it is even more important in the greenhouse of the Denver, Colo., vicinity where carnations form about 90% of the crop.

Carnation plants thrive on the bright sunshine of the area, but are very susceptible to cold weather and will split if exposed to it. Because of the altitude, a warm summer day often is followed by a chilly night. It is not unusual for a greenhouse to require cooling during the day and heating at night.

Through years of specialization in this field, Raymond and Ivan Petty, owners of the Petty Greenhouse Construction Co., have learned a great deal about building greenhouses for these conditions. In taking on a new contract, they guarantee that a desired temperature inside the building can be maintained with a variation of only 3 to 5 deg, even when the outside temperature goes as low as 10 deg F. The humidity can be controlled with equal exactness. In view of the large amount of glass involved, this requires careful design of the heating and cooling systems.

In a typical 24,000-sq-ft Petty greenhouse, such as that illustrated, a 78-hp boiler supplies heat that is carried through more than 8,000 ft of steel pipe. The piping is arranged in six zones, each equipped with motorized valves, actuated by thermostats, that maintain the temperature within plus or minus 5 deg.

Air cooling and humidification is achieved by pulling air through aspen pads that are kept moist by the constant drip of water. The pads are located along one side of the greenhouse, as shown at right in photo, and 48-inch exhaust fans are spaced every 20 ft along the other side.

As a result of experience, the Pettys have changed several of their practices. Formerly they installed heating pipes under the growing benches, as was customary in greenhouse construction. The grower sprinkled the soil and then allowed it to dry out from the heat, which was thought essential for maximum root action. In the new greenhouses, however, the pipes are run above the growing area, to heat the entire interior, using a low-pressure air cooling system to control the humidity.

In the greenhouses they build, the Pettys utilize Spang steel pipe, manufactured by the National Supply Division of Armco Steel Corp., Pittsburgh, Pa., for both the heating and water systems. The heating pipes are suspended from the basic structure of the building by adjustable jack chains.

NEW LITERATURE

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Aftercoolers

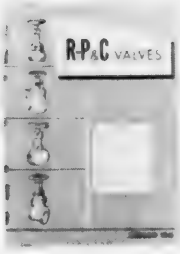
Paracoil Type AC aftercoolers, for compressed air and gas installations, are described in 8-page Bulletin 120, published by Davis Engineering Div., Tube Reducing Corp., Wallington, N. J. Engineering data include sizes and capacities of aftercoolers and associated moisture separators.

Circle **Item 1** on Inquiry Card

Baseboard Radiation

Slant/Fin Radiator Corp., Richmond Hill, N. Y., offers a 4-page publication, No. 30-10, describing its new ¾-inch Fine/Line baseboard. Low, narrow and silent, baseboard is suited to commercial buildings, apartments, banks, hospitals and homes. I-B-R ratings are included.

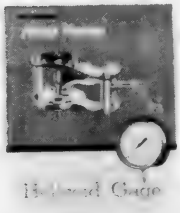
Circle **Item 2** on Inquiry Card



Valves and Accessories

Valves and accessories manufactured by R-P&C Valve Div., American Chain & Cable Co., Inc., Reading, Pa., are illustrated and described in 16-page Catalog 10-B. Line includes gate, globe, angle and check valves in bronze and iron; iron cocks; and accessories.

Circle **Item 3** on Inquiry Card



Indicating Gages

A 32-page catalog on pressure, vacuum and compound indicating gages is published by Helicoid Gage Div., American Chain & Cable Co., Inc., Bridgeport, Conn. Catalog DH-54 describes construction features and operation, and includes useful ordering information.

Circle **Item 4** on Inquiry Card

Expansion Valves

Four standard space-saving expansion valves designed for refrigeration and air conditioning constitute the "compact capacity" line offered by American-Standard Controls Div., Detroit, Mich. These valves are illustrated and described in Bulletin 262-B.

Circle **Item 5** on Inquiry Card

Refrigerant Filter-Driers

Eight-page Bulletin 200-61 provides tabular and descriptive information for sizing and selecting the line of ADK refrigerant filter-driers manufactured by Alco Valve Co., St. Louis, Mo. Bulletin lists advantages of the Dri-Kleaner's porous block construction.

Circle **Item 6** on Inquiry Card

Air Sampler

The Uni-Jet constant rate air sampler, made by Union Industrial Equipment Corp., Port Chester, N. Y., is improved to provide constant sampling rates that satisfy the most exacting tolerances, even in explosion hazard environments. A 4-page bulletin describes sampler.

Circle **Item 7** on Inquiry Card

Gas Fired Unit Heaters

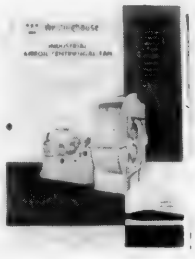
Gas fired suspended unit heaters featuring Resistal aluminized steel heat exchangers are offered for commercial heating applications by Mueller Climatrol Div., Worthington Corp., Milwaukee, Wis. A 4-page bulletin describes construction details and applications.

Circle **Item 8** on Inquiry Card

Air Cooled Condensers

Its BUVH series of air cooled condensers is described in 4-page Bulletin 2232 by Air Conditioning Div., Westinghouse Electric Corp., Staunton, Va. Models for horizontal or vertical air flow are covered by tables of heat rejection capacities, dimensions and specifications.

Circle **Item 9** on Inquiry Card



Industrial Centrifugal Fans

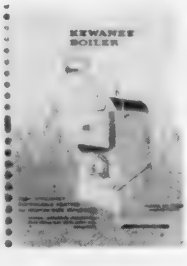
A series of industrial centrifugal fans, for heavy-duty applications, is described in 4-page Catalog 1122 by Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Mass. It includes operating features, construction details and engineering data on Series 8500 fans.

Circle **Item 10** on Inquiry Card

Air Scrubber

L-S air scrubbers, available from Antipol Corp., Galesburg, Ill., are described in a 4-page bulletin. Units offer 4-stage thoroughness in wet dust collection, and provide maximum recovery of air borne material. Bulletin includes operation, applications and dimensions.

Circle **Item 11** on Inquiry Card



Heating Boilers

An 8-page bulletin (No. 549B) describing Kewanee Square-Heat Type R boilers for heating medium-sized buildings is available from American-Standard Industrial Div., Detroit, Mich. Bulletin contains tabulated data on ratings and dimensions, and full selection data.

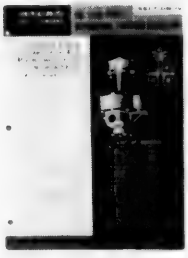
Circle **Item 12** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Straight Line Air Diffusers

An 8-page catalog giving complete information on its architectural straight line air diffuser is published by Anemostat Corporation of America, New York, N. Y. Catalog ASL-70 contains application and selection data, performance tables, and installation information.

Circle **Item 13** on Inquiry Card



Differential Pressure Regulators

Available from Atlas Valve Co., Newark, N. J., is a 2-page catalog sheet describing its No. 1200 and No. 1210 Type C differential pressure regulators for controlling the pressure of atomizing steam at an adjusted value higher or lower than the fuel oil pressure.

Circle **Item 14** on Inquiry Card

Boilers, Radiation and Accessories

Dunkirk Radiator Corp., Dunkirk, N. Y., announces a 16-page catalog covering the full line of Blue Circle gas, oil and stoker-fired boilers, as well as many types of cast iron and finned tube radiation. Catalog includes complete working data for hot water and steam systems.

Circle **Item 15** on Inquiry Card

Sewage Pumping

Twenty-eight page Bulletin 122-D describes the Flush Kleen sewage pumping system of Chicago Pump-Hydrodynamics Div., Food Machinery and Chemical Corp., Chicago, Ill. System is completely redesigned to handle modern high solids loadings without clogging or interruption.

Circle **Item 16** on Inquiry Card

Roof Ventilators

Complete details, specifications, dimensions and performance data on four types of propeller fan powered roof ventilators are included in 16-page Bulletin A-112E, published by Hartzell Propeller Fan Co., Piqua, Ohio. Data on penthouses and stack caps are also covered.

Circle **Item 17** on Inquiry Card

Flexible Metal Hose Assemblies

Flexible metal hose assemblies manufactured by The Hydro-Flex Corp., Topeka, Kan., are the subject of an 8-page bulletin. Besides illustrating and describing various types of assemblies, bulletin covers complete installation technique and lists cost-saving applications.

Circle **Item 18** on Inquiry Card

Power Roof Ventilators

Two bulletins are announced by Ilg Electric Ventilating Co., Chicago, Ill. Eight-page Bulletin DB3-200 describes Type L-CRF centrifugal power roof ventilators for exhaust applications; 8-page Bulletin DB3-100 contains selection data on propeller fan roof ventilators.

Circle **Item 19** on Inquiry Card

Water Heaters for Laundries

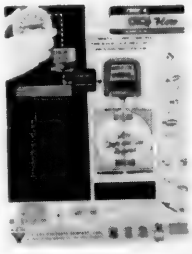
Laundro-Temp gas-fired water heaters for automatic laundries are the subject of 2-page Bulletin No. 23, published by Hydrotherm Inc., Northvale, N. J. Bulletin includes piping and wiring diagrams for a typical automatic laundry installation, plus table of capacities.

Circle **Item 20** on Inquiry Card

Carriers and Closet Fittings

Unitron carriers and closet fittings have features which, according to Josam Manufacturing Co., Michigan City, Ind., mean a saving of time, space and money in off-the-floor closet installations. Four-page Manual FG-2 describes construction advantages of these units.

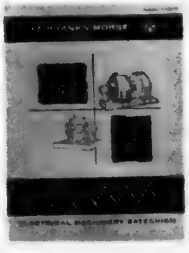
Circle **Item 21** on Inquiry Card



Damper Actuators

A 4-page catalog depicting installation of low cost, motorized Zone-A-Trol damper actuators to provide automatic zone control is available from Econo Products Co., Div. of Viking Instruments, Inc., East Haddam, Conn. It also describes use of a "dumper damper."

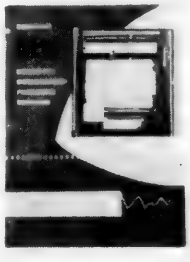
Circle **Item 22** on Inquiry Card



Electrical Machinery Catechism

Its newly-revised 48-page Catechism of Electrical Machinery is announced by Electrical Div., Fairbanks, Morse & Co., Freeport, Ill. It presents in simple form the most important aspects of common types of a-c and d-c motors, generators and control equipment.

Circle **Item 23** on Inquiry Card



Pneumatic Receiver

The Bristol Co., Waterbury, Conn., announces 6-page Bulletin No. A134 containing information on its Series 670 Metagraphic pneumatic receiver with a 4-inch chart width. Bulletin introduces the instrument and discusses its operation. A full-scale chart is reproduced.

Circle **Item 24** on Inquiry Card

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Combustion Air Heaters

Packaged combustion air heaters for power station and industrial process use are the subject of a 4-page bulletin released by Buffalo Forge Co., Buffalo, N. Y. Bulletin FD-800 describes heavy-duty removable core coil construction; 3 types of coils are available.

Circle **Item 25** on Inquiry Card

Accurate Valve Sizing

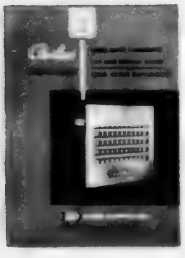
Accurate Valve Sizing for Flashing Liquids is the title of 10-page Technical Bulletin 108, prepared by the chief engineer of Conoflow Corp., Philadelphia, Pa. Specially constructed curves and known inlet conditions permit valve sizing with a few simple calculations.

Circle **Item 26** on Inquiry Card

Motor Valves

Specially designed for fan-coil units by Erie Manufacturing Co., Milwaukee, Wis., Motortrol Series 436A motor valves are described in 6-page Bulletin 210. Included are operating and construction specifications, flow diagrams, and a performance chart.

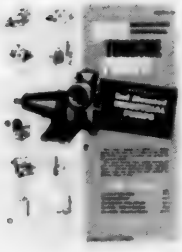
Circle **Item 27** on Inquiry Card



Gas Unit Heaters

Gas unit heaters, in fan and blower types, and gas duct furnaces are described in a 4-page bulletin by Peerless Manufacturing Div., Dover Corp., Louisville, Ky. Called Uni-Matic, units are fully covered by means of tables of specifications and dimensional data.

Circle **Item 28** on Inquiry Card



Regenerative Turbine Pumps

Two catalogs dealing with its regenerative centrifugal turbine pumps are announced by The Roy E. Roth Co., Rock Island, Ill. Twelve-page Bulletin 101 describes these end-mounted industrial pumps; 36-page Section C101 has performance curves, calculations.

Circle **Item 29** on Inquiry Card

Bathroom Cabinets, Accessories

A line of bathroom cabinets, mirrors and accessories is illustrated and described in a 28-page catalog (Form 6478) offered by Miami Cabinet Div., The Philip Carey Mfg. Co., Middletown, Ohio. Applications of these items include hotels, motels, hospitals and homes.

Circle **Item 30** on Inquiry Card

Acid-Resisting Pipe, Fittings

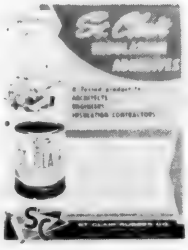
A 20-page catalog issued by Pacific Foundry and Metallurgy Co., San Francisco, Calif., describes the company's expanded line of Corrosiron high-silicon iron drain pipe and fittings. Catalog lists resistance to various chemicals, and illustrates over 300 items in line.

Circle **Item 31** on Inquiry Card

Packaged Centrifugal Pumps

Four-page Bulletin 117 PKG illustrates and describes the packaged line of Type GP close-coupled end-suction centrifugal pumps recently announced by Aurora Pump Div., The New York Air Brake Co., Aurora, Ill. Bulletin includes performance charts, dimensions, specs.

Circle **Item 32** on Inquiry Card



Insulation Adhesives

Insulation adhesive literature is offered by St. Clair Rubber Co., Detroit, Mich. Included are a 4-page catalog describing the company's various types of insulation adhesives, and separate catalog sheets on its lagging adhesive and lap sealing adhesive.

Circle **Item 33** on Inquiry Card

Welding Pressure Pipe Lines

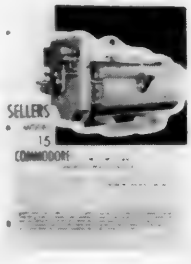
Offered by The Lincoln Electric Co., Cleveland, Ohio, is 20-page Bulletin 2112.2, "Welding Pressure Pipe Lines and Piping Systems." It contains practical information on manual and automatic techniques and costs; and API and ASTM specifications are reviewed.

Circle **Item 34** on Inquiry Card

Fan-Coil Type Unit

Publication 602-1 describes the Roommate II, a fan-coil type unit manufactured by John J. Nesbitt, Inc., Philadelphia, Pa. The 6-page bulletin includes capacities and specifications, and features a psychrometric discussion of the unit's humidity control system.

Circle **Item 35** on Inquiry Card



Immersion Heating Boiler

Model 15 Commodore low pressure steam immersion heating boiler is the subject of 4-page Bulletin 6010, published by Sellers Engineering Co., Chicago, Ill. Nine models are available ranging from 10 to 100 hp in size. Units are factory assembled, wired and insulated.

Circle **Item 36** on Inquiry Card

NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid yellow postcard in the back of the magazine for securing more information about new equipment and materials described in this department.

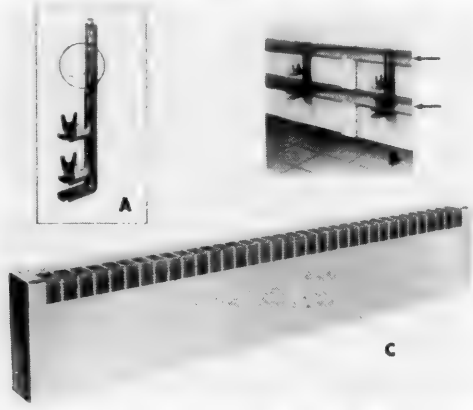
Finned Tube Radiation

Two new features which make installation easier, plus a curved outlet cabinet, have been added to the Wall-Fin line of finned tube radiation manufactured by The Trane Company, La Crosse, Wis.

As illustrated in photo, these features include:

(A) Supply and return pipe hanger which can be mounted to conceal piping at different levels within the cabinet. The new hanger costs less than a ball bearing element hanger for pipe support, and will accommodate 1-inch copper, 1¼-inch copper and 1¼-inch IPS pipe.

(B) Mullion channels which permit easier installation of radiation on panel or curtain walls. The



installer notches the channel to fit the required mullion spacing. Channels are then bolted to the mullions, using two channels for each run of Wall-Fin with enclosures. The channels can be used wherever construction interferes with attachment of brackets directly to the wall.

(C) The curved outlet cabinet brings Wall-Fin cabinet designs to four, including sloping outlet, front outlet and top outlet cabinets. Each is provided in 4- and 5¼-inch deep models and three standard cabinet heights.

More Information? Circle Item 37 on Inquiry Card.

Measures Temperature Differentials

A new development in the measurement of low temperature differences is announced by Hagan Chemicals & Controls, Inc., Pittsburgh, Pa.

Utilizing a Hagan HO PowrLog recorder for amplifying and recording, the instrument eliminates the need for a complex, expensive pre-amplifier when measuring very low temperature differences, such as Btu output on hot water boilers, or Btu removal by chilled water air conditioning systems.

Two standard assemblies are available. One is adjustable for a temperature difference range of 15 to 25 deg F and the second for a range of 50 to 200 deg.

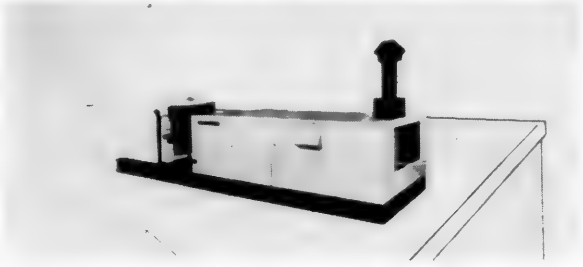
Other applications are for the measuring and control of humidity over narrow ranges by measuring the difference between wet and dry bulb temperatures, measuring the temperature rise across a pump, and measuring air heater efficiency.

More Information? Circle Item 38 on Inquiry Card.

Roof-Mounted Equipment

A space saving, economical heating and air conditioning concept for roof mounted equipment has been developed by Airtemp Div., Chrysler Corp., Dayton, Ohio, who announces the new models as the 1109-00, 1112-00 and the 1116-00. The nominal capacity for each model is 7½, 10 and 15 tons, respectively.

The combinations possible with the three different models are reported to take care of any roof top installation. Units are designed for jobs which require cooling only, heating only or year-round air conditioning. Some of the possibilities include:



1. Packaged air conditioning, saving valuable interior space.

2. Packaged heating and cooling equipment with either stainless steel or aluminized steel heat exchangers on the gas-fired furnaces to satisfy all code requirements.

3. Year-round air conditioning with a remote condensing unit.

4. Year-round air conditioning with two remote condensing units. This application would be suited for installations with changing load conditions. Only one condensing unit would be used during light load condition, saving the customer money.

5. A series of year-round air conditioning units using one large condensing unit.

6. An outdoor furnace with provisions for a year-round air conditioning system at a future date.

More Information? Circle Item 39 on Inquiry Card.

Commercial Gas Water Heaters

A line of commercial gas water heaters, that according to the manufacturer delivers large-volume, high-temperature water at lower cost because of longer tank life, is announced by Ruud Manufacturing Co., Kalamazoo, Mich., a subsidiary of Rheem Manufacturing Co. The new line comprises nine Ruud Copper Sanimaster models with tanks of pure, solid copper reinforced with steel.

The tank, the manufacturer says, is highly corrosion-resistant in the most aggressive waters and will not rust at any temperature or under the most severe operating conditions.

Designed to meet modern requirements of all commercial, industrial and institutional buildings, these units utilize hourly heat inputs from 55,000 to 360,000 Btu and deliver from 46 to 300 gal at 100 deg F temperature rise. When connected in duplex, triplex and four-plex with Ruud Equa-Flow manifolds for operation as a single unit, tops of 1,440,000 Btu input and hot water delivery of 1200 gallons an hour are reached.

More Information? Circle Item 40 on Inquiry Card.

Low Cost Conversion Process

Aqua-Chem, Inc., (formerly Cleaver-Brooks Special Products), Waukesha, Wis., pioneer and leading manufacturer of flash evaporation and vapor compression sea water conversion equipment, announces commercial availability of a new electrodialysis process to convert brackish water into fresh water at a cost substantially below that possible with any equipment currently in operation.

According to operating reports, the process has actual conversion costs of 54 cents per thousand U. S. gallons at a 2,800,000 gallon a day brackish water plant for gold mines in southwest Africa. The cost figure is based on a 15 year program for the redemption of capital and accumulation of interest.

For comparison, a figure of 35 cents to 50 cents per 1,000 gallons is commonly used as an average cost of delivering conventional fresh water to consumers in the United States.

This is reported to mark the first time that any manufacturer of large saline water conversion equipment is able to offer either evaporating water conversion or electrodialysis equipment, whichever suits the application best, and thus provide unprejudiced counsel for the user.

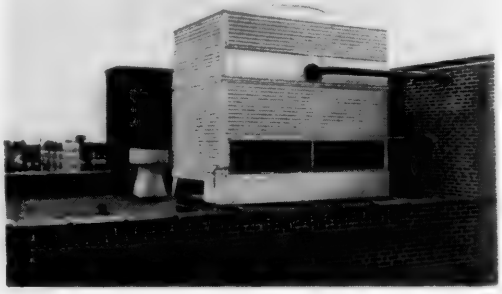
In the electrodialysis process, brackish water is fed between two ion permeable membranes and an electric current is passed through the cell. The membranes are so designed that one is selective to positively charged ions and the other to negatively charged ions. One membrane passes negative ions and the other positive ions with the result that the water in the stream between the membranes becomes purified while the water on the opposite sides of the membranes become concentrated with salinity.

More Information? Circle Item 41 on Inquiry Card.

Water Cooling Towers

A line of water cooling towers is introduced by The Marley Co., Kansas City, Mo. Trade-named CompacTowers, this new line covers a capacity range upward from 100 tons, nominal.

Company reports that this design provides a new level of adaptability unique in towers of this capacity range. It saves weight: "curtain-wall" casing, honeycomb segments in filling, air intake and air discharge areas, plus advanced design cold water basin minimize operating weight. This feature (low operating weight) is of particular importance when CompacTowers are applied to existing buildings not originally designed for heavy roof loading.



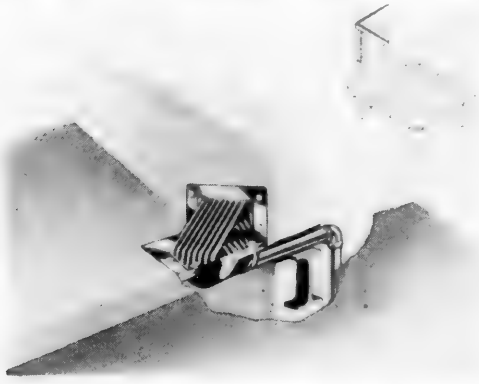
It saves time: erection is fast; towers ship in two easy-to-join sub-assemblies. All models are modular units with uniform height and width dimensions permitting easy multi-cell installations. Simplified wiring and piping further reduces installation time. All internal areas are readily accessible for inspection and maintenance through conveniently located access panels.

More Information? Circle Item 42 on Inquiry Card.

Roof Drain for Vertex Marquees

To meet the aesthetic and practical demands of modern roof construction methods, Hydromechanics Div., Zurn Industries, Inc., Erie, Pa., has developed an angle-type drain suitable for installation in vertex marquees.

Drain blends unobtrusively with this modern mode of roof construction. It further enhances the eye-appeal of vertex marquees, because it eliminates



the need for gutters and exposed drain lines which in the past detracted from the appearance of this type of roofing construction.

From the practical standpoint, the large open area ratio assures rapid draining of marquee valleys, and its construction provides for complete sealing of roofing felts and flashing. Designated the Z-184, drain will accommodate a wide range of slopes, as well as a great variety of insulation and fill depths.

More Information? Circle Item 43 on Inquiry Card.

Duct Insulation Improved

An improved spun mineral fiber duct insulation, said to have superior rigidity and strength at no sacrifice in thermal insulating qualities, is announced by Baldwin-Ehret-Hill, Inc., Trenton, N. J. The new resin-bonded material is called E-Z Ply because its improved mechanical properties will make it much easier to handle and apply, with less waste due to breakage, than earlier duct insulations, the company explains.

Insulation is available either plain or with the following factory-applied facings: black kraft paper vapor barrier bonded with a thick coat of high-penetration asphalt; scrim-reinforced aluminum foil laminated with flame proof kraft paper; embossed aluminum foil; and neoprene. Facing corners of the black kraft paper are pre-folded to insure square, flat edges so that adjacent panels will butt together tightly.

It has a thermal conductivity ("k" factor) of 0.24 at a mean temperature of 75 deg F, and its maximum temperature limit is 450 deg. It comes in 2 x 4-ft panels in thicknesses of 1, 1½ and 2 inches. Light in weight and easy to cut to shape with a knife, it can be applied by any of the conventional methods of installing semi-rigid duct insulation.

More Information? Circle Item 44 on Inquiry Card.

Air Curtain

Announced by Curtainaire of California, Glendale, Calif., is a new electric unit called the Conditionaire. Installed over any door, this unit forces a thin curtain of air across any open entry. This air curtain serves the same purpose as an actual door, even though customers or workers freely pass through the opened entry without the slightest inconvenience.

In air conditioned or cold storage areas, the curtain keeps hot weather out, keeps cool or cold air in. Used in supermarkets, meat packing and frozen food storage areas, the units have paid for themselves in a few months by reducing refrigeration costs and labor costs of opening and closing doors, the firm reports.

The unit is completely self-contained, connects to standard electrical wiring systems, costs as little as ¼c per hour to operate. A ¼-hp electrical motor runs the unit, requires virtually no maintenance.

More Information? Circle Item 45 on Inquiry Card.

Three-Foot Baseboard

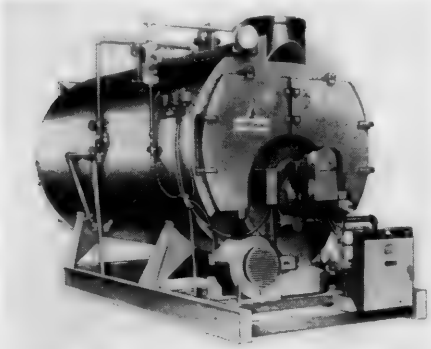
John J. Nesbitt, Inc., Philadelphia, Pa., announces the addition of a three-foot length to its line of baseboard radiation products. The new enclosure and element along with the standard line of 4-5-6 and 8-ft lengths will provide contractors with even greater flexibility and eliminate any cutting on the job site, the manufacturer states.

All five lengths of enclosures and elements are packaged separately at the factory in exact quantities to fit the specific job.

More Information? Circle Item 46 on Inquiry Card.

Scotch Package Generators

A 2-pass Scotch package generator with a rated output up through 600 hp has joined the IronFirepak line of Iron Fireman Mfg. Co., Cleveland, Ohio. Available in both a wet back version producing either steam or hot water and in a dry back design for steam process work, the 202 Series can be fired with gas, oil or gas-oil in combination.



The low pressure model—the 202L—provides heating for large commercial and industrial buildings. The high pressure model—the 202H—is designed for 100, 125 and 150 psig steam, and is normally used in commercial-industrial process work.

Also added to the IronFirepak line is a 4-pass Scotch package generator that eliminates refractory baffles and has wet back construction.

The 400 Series comes in two types. The 400L (fired by gas, oil or gas-oil) is a low pressure model with a rated output of 50 through 100 hp which is designed for 15 psi steam or 30 psi water. The 400H (also gas, oil or gas-oil) is a high pressure model designed for 100 through 150 psig steam; rated output is 30 through 100 hp.

Heating small commercial buildings is the job of the 400L, while the 400H can be used by dairies, laundries, dry cleaners, hospitals, moderate-sized plants and other small commercial-industrial facilities that use steam for process work.

More Information? Circle Item 47 on Inquiry Card.

Dust Collector Introduced

Vacculator Co., Inc., Newark, N. J., offers a line of cabinet-type dust collectors for which a high efficiency is claimed. Three models, designated F.G.M. 5, 10, and 15 are powered with ½, 1. and 1½-hp motors respectively, affording approximately 400, 600, and 900 cfm capacities.

Each unit has two electrostatic filters placed in series. All models are mounted on rubber supports, are portable, completely fireproof, and are equipped with aluminum alloy impellers for spark-resistance. They also have exhaust silencers.

More Information? Circle Item 48 on Inquiry Card.

Gas-Fired Unit Heater

Mueller Climatrol Div., Worthington Corp., Milwaukee, Wis., announces the production of gas-fired unit heaters in capacities ranging from 25,000 to 225,000 Btuh input with special Resistal heat exchangers.

The company stated that the aluminized steel heat exchanger will improve the performance and extend the life of the unit heater. Resistal heat exchangers will withstand higher temperatures without scaling or discoloring more than ordinary steel exchangers, the firm reports.

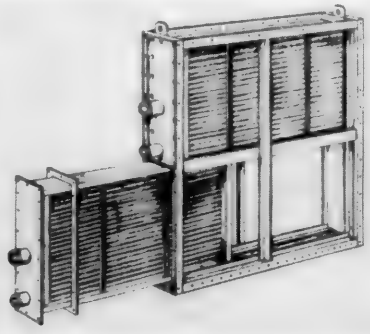
Unit heaters are shipped completely assembled with controls prewired and drilled cast-iron burners in place. These units are approved by the American and Canadian Gas Associations for use with natural mixed, manufactured or propane gas.

More Information? Circle Item 49 on Inquiry Card.

Air Combustion Heaters

A line of "packaged" air combustion heaters for power station and industrial process use is available from Buffalo Forge Co., Buffalo, N. Y.

Designed for installation in ductwork breeching, the units feature removable core coils and Aerofin tubing. Shipped in one-piece assemblies, these air combustion heaters are ready for mounting ahead of or behind forced air fans.



Heavy-duty core coils are pitched in the casing for either horizontal or vertical air flow, to provide proper condensate drainage and to prevent possible freezing. Temperature of heated air is uniformly maintained across the face of the coil. Coil tubes, equipped with smooth, tapered fins, assure maximum heat transfer, and can withstand temperatures to 700 deg F.

Steam heating coils are available with ⅝ or 1-inch OD, thick wall copper tubing. Hot water coils are available in the same OD tube sizes. Cupro-nickel tubes are also available.

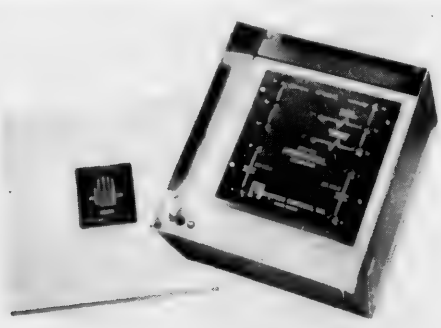
More Information? Circle Item 50 on Inquiry Card.

Alternator Control for Duplex Equipment

A new controller, the Protectal Alternator, has been developed by Protection Controls, Inc., Skokie, Ill., for reliable actuation of duplex equipment.

Applications include duplex pumps in boiler water return systems, storage tanks, sump and sewage units, and various fluid process systems; also air conditioning equipment.

Outstanding design feature, the firm points out,



is a simplified, yet fool-proof, alternating mechanism which has a minimum of moving parts, and requires no lubrication or adjustments. Entire assembly is mounted on a single, removable panel.

The Alternator is controlled by conventional pilot devices—float controls, pressure switches, thermostats, probes, etc.—and its two heavy duty solenoids (one for emergency use) unfailingly operate separate pump switches at predetermined time intervals or when specific fluid levels are reached.

More Information? Circle Item 51 on Inquiry Card.

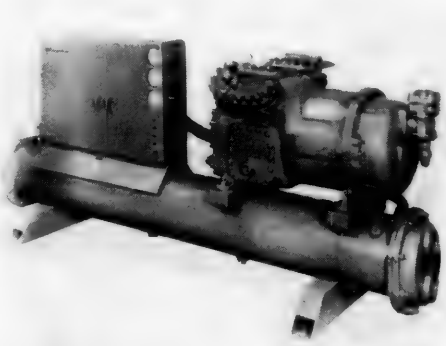
Hermetic Condensing Units

A line of hermetic condensing units (Model CNU) is available from Air Conditioning Div., Westinghouse Electric Corp., Staunton, Va. The units, in ratings from 20 to 60 tons, are designed for use in field assembled commercial and industrial air conditioning equipment.

Suction operating temperatures from 20 to 50 deg F are standard. Temperatures outside this range are available for special applications.

There are six voltage ratings at three phase, 60 cycles: 208, 220, 240, 440, 480, and 550; at three phase, 50 cycles, three ratings: 220, 380, and 400. All units are equipped with either line-start or part-winding-type starters.

Each condensing unit consists of a water-cooled condenser, a Type CLS hermetic compressor, and a control center. It is factory assembled, completely prewired and prepiped, and includes vibration mount-

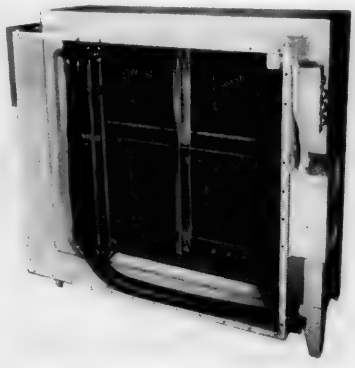


ings under the compressor. Starters, safety controls, gage panel, and all internal control and power wiring between control center and compressor are included as standard items.

More Information? Circle Item 52 on Inquiry Card.

Packaged Electronic Air Cleaner

A completely self-contained high velocity electrostatic precipitator is introduced by American Air Filter Co., Inc., Louisville, Ky. The Type HVSC Electro-Cell air filter is designed for use in inaccessible areas and for use with air handling units. It is complete with front and back duct connections, drain pan and pre-assembled washing and oiling mechanism, and is available for either floor or ceiling mounting.

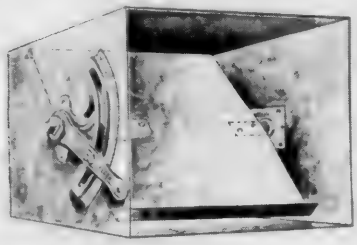


Unit is available in 24 sizes ranging from 1,000 to 25,000 cfm. The high velocity cells are shipped in specially-designed cartons for easy field installation. Since the unit is shipped complete, installation and wiring of the Power Pack and adhesive pump, and hooking up the water and drain connections are all that is necessary on the job site.

More Information? Circle Item 53 on Inquiry Card.

Leakproof Damper Regulator

A development by Elgen Manufacturing Corp., Long Island City, N. Y., provides completely rattleproof and 100% leakproof damper regulator installations. Designed for top quality duct work and high velocity systems, the new unit is called the Quadra-Matic.



One of its most unusual features is a polyethylene sealer component that is placed into the quadrant handle. When the handle is fitted on the square end bearing of the damper blade, and set flush against the side of the duct, a 100% airtight contact is assured, the firm reports. In addition, the shaft of the square end bearing is knurled to hold the sealer securely. Once the quadrant and handle are in final position, all rattles usually accompanying such installations are completely and permanently done away with.

More Information? Circle Item 54 on Inquiry Card.

Copper Tube Fittings and Valves

Chase Brass & Copper Co., Waterbury, Conn., announces that it has added 900 new items to its copper tube fittings and valve lines. The additions, which include a complete line of Hammond bronze valves comprising approximately 500 items by size and type, make available from Chase what is said to be the most complete line of tube, fittings and valves from one source in the United States.

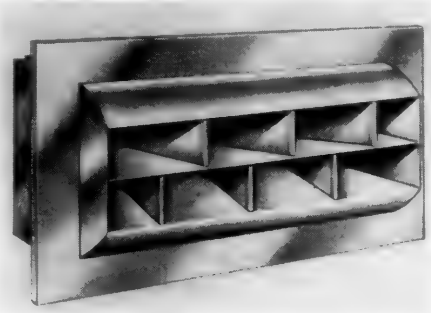
Among the Hammond items are heavy-duty valves meeting federal specifications, solder joint valves for use with copper tubing, a complete line of heating specialties, and a standard line of gate, globe, angle and check valves, boiler drains, sill faucets, stops and stop and wastes.

Included in the other 400 items are: 21 new styles of cast drainage fittings, new wrought copper drainage fittings, wrought copper expansion joints, and wrought copper air chambers. Among the new sizes are: 109 wrought pressure fittings, 142 cast pressure fittings, 18 wrought drainage fittings, and 131 cast drainage fittings.

More Information? Circle Item 55 on Inquiry Card.

Cylinder Type Diffusers

Air Devices Inc., New York, N. Y., announces a series of extruded aluminum, cylinder type, Roto-Jet diffusers for heating and cooling applications in any large interior where long projection of air or modulated diffusion is required.

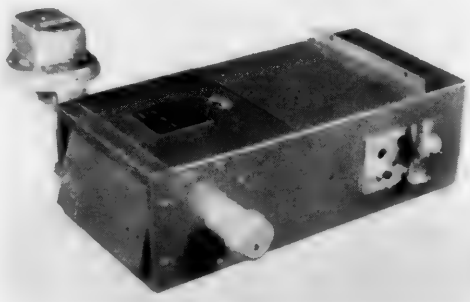


The design incorporates a rotary cylinder and split diffusing vanes. The cylinder can be adjusted for upward, downward or straight out projection. The split diffusing vanes can be adjusted for air direction blows—left, right or for modulated diffusion. Diffusers can be installed either in a horizontal or vertical position, as required.

More Information? Circle Item 56 on Inquiry Card.

Gas Conversion Burners

Roberts-Gordon Appliance Corp., Buffalo, N. Y., introduces the Series 26 line of commercial-industrial gas conversion burners.



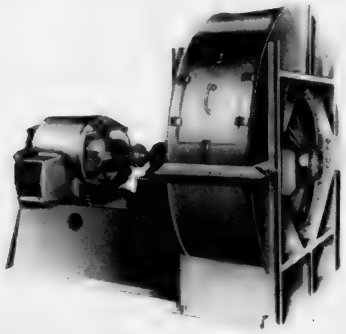
Series 26 is an atmospheric burner ranging in inputs from 600,000 to 1,050,000 Btuh. Each burner is furnished with an automatic pilot, or optional electronic pilot at extra cost, with flame electrode and M-H protecto-relay, automatic main gas valve and gas pressure regulator. Accessories that are available as optional extra equipment include draft, safety, operating, limit and combustion controls and instruments.

More Information? Circle Item 57 on Inquiry Card.

Industrial Centrifugal Fans

A new series of heavy-duty industrial fans (Series 8500) is announced by Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Mass. Featuring the use of airfoil blading, the centrifugal fans are tailored specifically for high efficiency at direct-connected motor speeds. The units are well suited for applications such as combustion air for steel mill and industrial furnaces; packaged steam boilers; and for industrial processes such as glass cooling, vacuum drying and exhaust from aluminum pot lines.

Fans are consistent with an industrial trend to direct-drive-type machinery because of its reliability in continuous operation. Direct drive also extends application possibilities where fan speeds or horsepower input exceed belt drive limitations.



With capacities from 15,000 to 450,000 cfm, the units are available in five a-c direct-connected motor speeds: 1800, 1500, 1200, 900 and 750 rpm. Within this range are included ten sizes of AMCA Class III-type fans with wheels from 30 to 81 inches in diameter; and fourteen sizes of AMCA Class IV-type fans with wheel diameters from 30 to 109 inches. The fans can handle air from —20 to 800 deg F.

More Information? Circle Item 58 on Inquiry Card.

Thermal Shock Guarantee

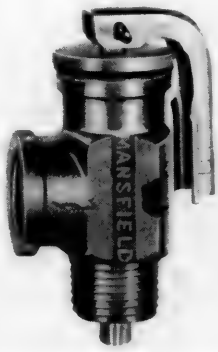
Boiler purchasers can now, for the first time it is reported, acquire hot water boilers with a three-year manufacturer's guarantee against damage from so-called "thermal shock," a source of many boiler failures. This means that boiler owners and design engineers are protected against loss from structural failures of boiler pressure vessels usually attributed to flow rate or temperature difference of return water.

The guarantee was announced by Boiler Engineering & Supply Co., Inc., Phoenixville, Pa. The guarantee applies to the company's Continental automatic packaged boilers used for industrial, institutional, and commercial applications.

More Information? Circle Item 59 on Inquiry Card.

Line of Relief Valves

A new line of relief valves for use in all types of pressure systems is announced by Mansfield Sanitary, Inc., Perrysville, Ohio.



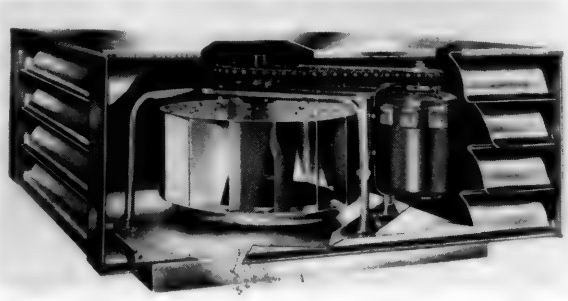
Available with 15 to 200 psi settings, valves have Neoprene seals, stainless steel springs, and cast red brass bodies. Some are equipped with calibrated adjusting keys. Standard setting is 125 psi.

Valves are said to be suitable for use wherever pop-off or by-pass type relief units are needed. Applications include drilling, punching, sleeve cylinders, steam lines, water pumps, storage tanks, spray equipment and hydraulic and pneumatic systems. Special units are available for high temperature use.

More Information? Circle Item 60 on Inquiry Card.

Centrifugal Roof Ventilators

A new style in low silhouette centrifugal roof ventilators is announced by Western Engineering & Mfg. Co., Los Angeles, Calif. This unit, to be known as the Western Centridyne, features aerodynamically designed extruded aluminum discharge vanes. The straight-line styling and low, compact shape are engineered to harmonize with the linear design concept of modern architecture.



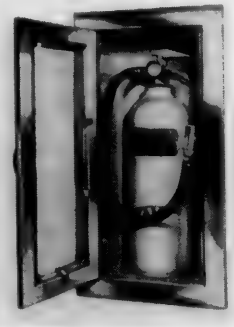
Unit also features quietness of operation, non-overloading horsepower and a stable pressure curve. Exhaust is directed horizontally rather than in the conventional downward direction, thus preventing roof damage or deterioration, the firm points out. The low silhouette is achieved by mounting motor in the wheel plane.

Models range from ⅛ to 5 hp with wheel diameters from .990 up to 3.000 ft. Heights range as low as 11½ inches.

More Information? Circle Item 61 on Inquiry Card.

Complete Fire Control Center

New triple-service Fyr-Fyter All-Purpose dry chemical fire extinguisher, now available for built-in wall cabinet installation, greatly simplifies and speeds modern-day interior fire protection.



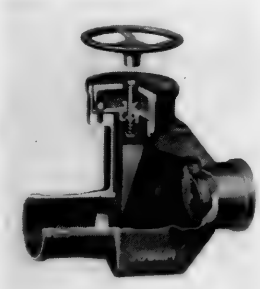
Announced by The Fyr-Fyter Co., Dayton, Ohio, the extinguisher is Underwriters' and Factory Mutual approved for combatting "all" classes of fire: general combustible, burning liquid and electrical fires. Cabinet equipped with the All-Purpose extinguisher thus becomes a complete fire control center.

No longer must two or three separate types of extinguishers be provided in order to achieve full protection against all possible fire contingencies, the company points out. No longer need there be a risk of unfamiliar hands accidentally choosing and using the wrong extinguisher.

More Information? Circle Item 62 on Inquiry Card.

Backwater Valve Offered

According to Josam Manufacturing Co., Michigan City, Ind., its Series No. 1140-ZZ backwater valve provides two important protective features: an automatically operating flap valve and a manually operated gate valve. Vanes on the flap valve are designed so that the water will spin the flap to clean the seat. Gate valve is spade shaped so that it will cut through sewage and debris.



The automatic flap valve closes at the slightest backflow and prevents water from backing up into basements from overloaded sewers during sudden storms. If protection is desired during long periods of time, the manually operated gate valve is closed until waste lines to sewers can be used again.

Both valves are easily accessible from the floor level and the wheel handle is removable so that the top of the valve fits flush with the floor.

More Information? Circle Item 63 on Inquiry Card.

Totalizing Liquid Flow Meter

The Model 380 Propeloflo Meter, a propeller-type totalizing flow meter, is available from B-I-F Industries, Providence, R. I., manufacturer of meters and systems for positive control of materials flow. Called ideal for metering water and other liquids in water works and chemical or process industries, the Model 380 is as easily installed as a length of pipe.

Highly accurate because of its precision meter mechanism, it requires no pipes or mercury and totalizes directly. The high tensile cast iron body construction with molded plastic propeller of high impact strength makes possible a sturdy, durable meter that will withstand and register overloads up to 150%.

Available in eight different line sizes, the meter can measure flow from a minimum of 20 up to 2400 gpm, depending upon line size, with measurement accuracy within ±2% of actual flow over the rated operating range, including temporary flow rates up to 150% of rated capacity.

More Information? Circle Item 64 on Inquiry Card.

Electronic Temperature Controls

Interior temperature changes controlled electronically are provided by a system called Conditionaire, premiered recently on the West Coast by Fischbach and Moore, Inc., New York, N. Y.

Representatives pointed out that the system incorporates the use of transistors, rather than the vacuum tubes used in other systems, which is seen

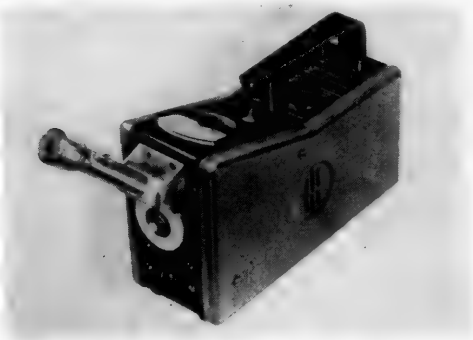
as enhancing reliability and performance. Power actuators are driven directly by the transistors, thereby eliminating relays.

Conditionaire modules permit tailoring of the system to suit individual requirements of buildings. The desired control function is effected by simply plugging the necessary combination of modules into the central control unit.

More Information? Circle Item 65 on Inquiry Card.

Sound Level Meter

H. H. Scott, Inc., Maynard, Mass., manufacturer of sound measuring and analyzing instruments, announces a sound level meter designed to the new S1.4-1961 ASA Standard. Called the Model 412, it operates over the exceptionally wide frequency range of 5 cps to 30 kc. A ceramic microphone allows the unit to be used in temperatures ranging from 0 degrees to 170 deg F. There is a built-in electro-acoustic calibrator to insure consistent accurate readings at all times. The meter operates on two batteries plus a single bias cell. Circuitry includes seven transistors.



Sound level meter will allow precise measurement of noise and sound in any location indoors and out, the company explains. It will find extensive application in measurement of intensity of noise, and for determination of possible hearing damage. It will be useful in surveying the psychological and physiological effects of noise.

More Information? Circle Item 66 on Inquiry Card.

Commercial Water Heater

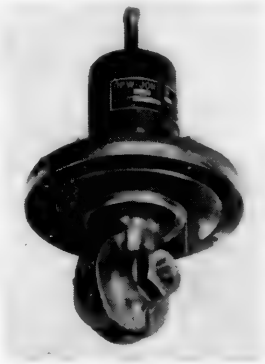
The Jetglas commercial water heating line of the Day & Night Mfg. Co., La Puente, Calif., has been expanded by the addition of a 500,000 Btu input instantaneous heater. Introduced as the Model 65-420 "JIB," this instantaneous booster combines a 65 gallon storage capacity with a 420 gph recovery capacity at 100 deg rise. It will carry the 5 year warranty (2 unconditional, 3 pro-rated) which the firm places on all products in its commercial water heater line.

Heater is approved by American Gas Association and National Sanitation Foundation for 180 deg F application as both a free-standing "automatic instantaneous" water heater and a "Type A automatic circulating tank heater." Therefore, unlike ordinary booster heaters, it may be used singly or in multiples either with or without a separate storage tank. It will be available in both standard and ASME code models.

More Information? Circle Item 67 on Inquiry Card.

Sensitive Pressure Regulator

OPW-Jordan Corp., Cincinnati, Ohio, announces an extra sensitive pressure regulator, available from stock in ductile iron (160A) or bronze (260A) in ¼, ⅜, ½ and ¾-inch sizes.



In a severe test on steam service with 20 psi inlet and 7 psi outlet, the valve showed a swing of only plus or minus .1 psi. Pressure regulation is called equal to piloted valves without the trouble associated with pilots.

Self-operated valve is suitable for steam, water, air, oil, gas or chemicals. Pressure control range is from .5 to 125 psi. Stainless steel self-cleaning and self-lapping Sliding Gate Seats are standard and feature tight shut-off. Suitable for 250 psi at 500 deg F, valves offer maximum pressure drop of 175 psi, minimum pressure drop of 3 psi.

More Information? Circle Item 68 on Inquiry Card.

Square Panel Fans

Propellair Div., Robbins & Myers, Inc., Springfield, Ohio, announces a line of square panel fans that feature fast installation, quiet performance, and a single nameplate guarantee for both the fan and motor. The line contains three models:

Direct connected Type PQ in six sizes from 12 to 36-inch fan diameter, delivering 1,235 - 10,860 cfm under free air conditions, as recommended for offices, churches, and similar locations where extremely quiet operation is desired.

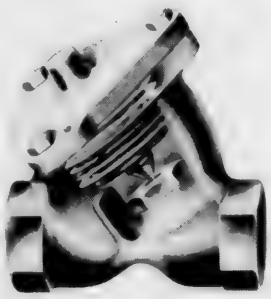
Direct connected Type PD (shown) in five sizes from 24 to 48-inch dia., delivering 4,700-32,200 cfm of free air, for industrial use to exhaust smoke, dust, and fumes, or as circulators and man coolers.

Belt driven, heavy duty, slow speed Type PB in sizes of 42, 48, and 60-inch dia., with 14,320-52,700 cfm free air, used in general manufacturing, commercial, and institutional applications for greater air movement at relatively low noise levels.

More Information? Circle Item 69 on Inquiry Card.

Thermostatic Steam Trap

A new thermostatic steam trap for pressures from vacuum to 150 psig and temperatures to 425 deg F has been developed by W. H. Nicholson and Co., Wilkes-Barre, Pa.



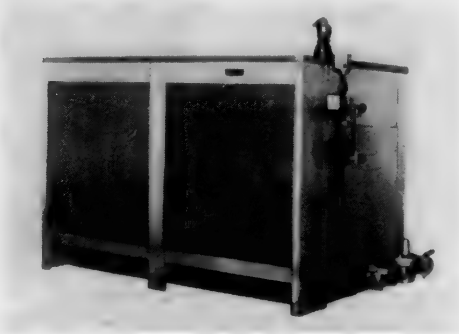
Known as the Nicholson N-150 and designed primarily for tracer lines and small pieces of steam processing equipment, etc., the trap comes in ½ and ¾-inch sizes and operates on a true balanced pressure principle. Called ideal for rugged service, it has a cast steel body and forged steel cover. The bellows is Monel metal for high resistance to corrosion, and the hardened stainless steel valve and seat are lapped together for tight, positive shut-off.

Another feature, the company-developed steam-saving baffle, deflects live steam upward to envelop the bellows. This is reported to result in fast, snap-closed action and a greater degree of steam saving efficiency, as confirmed by tests conducted by the U. S. Testing Company.

More Information? Circle Item 70 on Inquiry Card.

Cast Iron Boiler

The Peerless Heater Co., Boyertown, Pa., introduces its Series 170 gas-fired cast iron boiler, available in deluxe or flush type, two-toned green enamel jackets. Series is manufactured in 33 sizes ranging from 680,000 to 6,120,000 Btuh input, and can be used with natural, mixed, manufactured and L.P. gases.



Boiler is designed for heavy duty operation in commercial, industrial, government and office buildings, hotels, churches, schools, hospitals, apartments and sewage disposal plants.

More Information? Circle Item 71 on Inquiry Card.

Electric Heat Thermostat

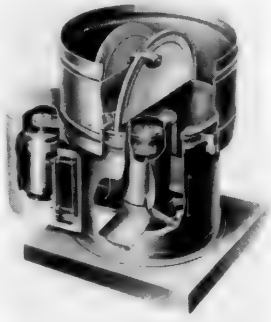
Penn Controls, Inc., Goshen, Ind., announces a new type of room thermostat for electric heating equipment. Designated the Type 802 Switchstat, it includes a sensitive 5000 watt capacity thermostat and provision for mounting as many as three interchangeable wiring devices such as switches, pilot lights or convenience outlets.

Called especially suitable for service in bathrooms with ceiling type units in combination with lights and exhaust fans, the control is also a convenient and attractive unit for kitchens, recreation rooms, hallways, bedrooms, offices and motels.

More Information? Circle Item 72 on Inquiry Card.

Belt-Driven Ventilators

Belt-driven units for installations where hot, moist, corrosive, or fume-laden air is exhausted are added to the line of power roof ventilators made by L. J. Wing Mfg. Co., Linden, N. J.



In Wing-Jet belt driven ventilators, the fan is belt-driven by a motor mounted in a weather-proof housing outside the gas stream. Rigid motor supports are welded to the outside of the ventilator casing. Belt tension is readily-adjusted.

Units are available in twenty sizes and free air capacities from 2000 to 60,500 cfm. Capacities at ½ inch static pressure range from 1350 to 53,000 cfm.

More Information? Circle Item 73 on Inquiry Card.

Push Button Diverter Valve

Described as a new concept in safe and easy-to-operate bathtub showers, the S-1777 Sentinel "push button" diverter shower is introduced by Speakman Company, Wilmington, Del.

This shower is equipped with a push button diverter valve, installed chest-high, that is designed to help reduce falling accidents which sometimes occur in tub showers. The higher location of the diverter valve eliminates the chance of the bather losing his balance while bending over to reach a lift button on the tub spout—a motion that is necessary with most conventional tub showers.

This feature is called especially valuable to motels, hotels and showering facilities for the aged.

More Information? Circle Item 74 on Inquiry Card.

Oil Furnace Line

An expanded line of oil-fired furnaces, designed to provide continuous circulation of filtered air under all operation conditions, is announced by The Coleman Company, Inc., Wichita, Kan.

Capacity range of 85,000 to 325,000 Btuh meets the heating requirements for all homes and most commercial buildings, the firm reports. Blowers are adequate for add-on central air conditioning.

Four highboy, 3 counterflow, 5 lowboy and 7 horizontal models make up the new oil furnace line. Heat exchangers are made of 14-gage steel; combustion chambers are of stainless steel construction.

Special construction of the combustion chamber and built-in sound control features are reported to insure quiet operation.

Burners and all controls are factory-mounted within the furnace enclosure on all highboy, lowboy and counterflow models.

Circle Item 75 on Inquiry Card.

Top-Entry Ball Valves

A completely new line of top-entry ball valves is introduced by Strong, Conneaut, Ohio.

Line features a one-piece body design constructed from cadmium-plated carbon steel, or from stainless steel bar stock, to give maximum safety, strength and economy. They are the first ball valves to offer both rugged bar stock construction and easy-to-service top entry design in a single unit, the company announces.

The Evrtyte ball valves are precision-engineered for dependable, economical on-off valving of gas, air, oil, water or liquid chemicals. Threaded inlet and outlet connectors permit fast, positive installation in ⅜, ½, ¾ and 1-inch lines. A large arrow indicating the flow direction is cast into the valve body to avoid installation errors.

Circle Item 76 on Inquiry Card.

MAID-O-MIST Inc.
HEATING SPECIALTIES

get MORE with AUTO-VENTS®

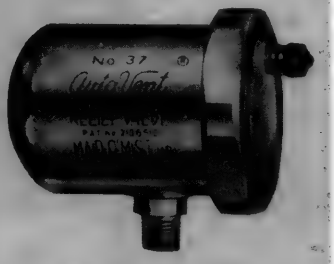
No. 7 for vertical mounting. 4⅜" x 2¼" with ⅜" I.P. female connection

MORE for your money . . .
MORE to select from . . .
MORE effective venting of air in

No. 67 for vertical mounting. 3-3/16" x 1⅞", with ¼" I.P.T. male connection.

(hydronic) hot water heating and chilled water cooling systems

Choose from No.'s 7-67-37-72 Auto-Vents for your specific need



No. 37 for horizontal mounting only, 3" x 2¼", with ⅜" I.P. vertical male bottom connection.

There's a MAID-O'-MIST Auto-Vent designed for the mounting, the space and the capacity you need. The most complete line of float operated automatic air-eliminators. Don't be misled by their modest price . . . they do a terrific job. Venting air *CONTINUOUSLY*, they get rid of air-pockets that prevent the free flow of water. And they're fast, easy to install. See *ALL* MAID-O'-MIST'S Auto-Vents–

No. 72 (disc type) for vertical or horizontal mounting. 1¾" x ⅜" with ⅜" I.P. male connection

WRITE FOR CATALOG

MAID-O'-MIST, Inc.

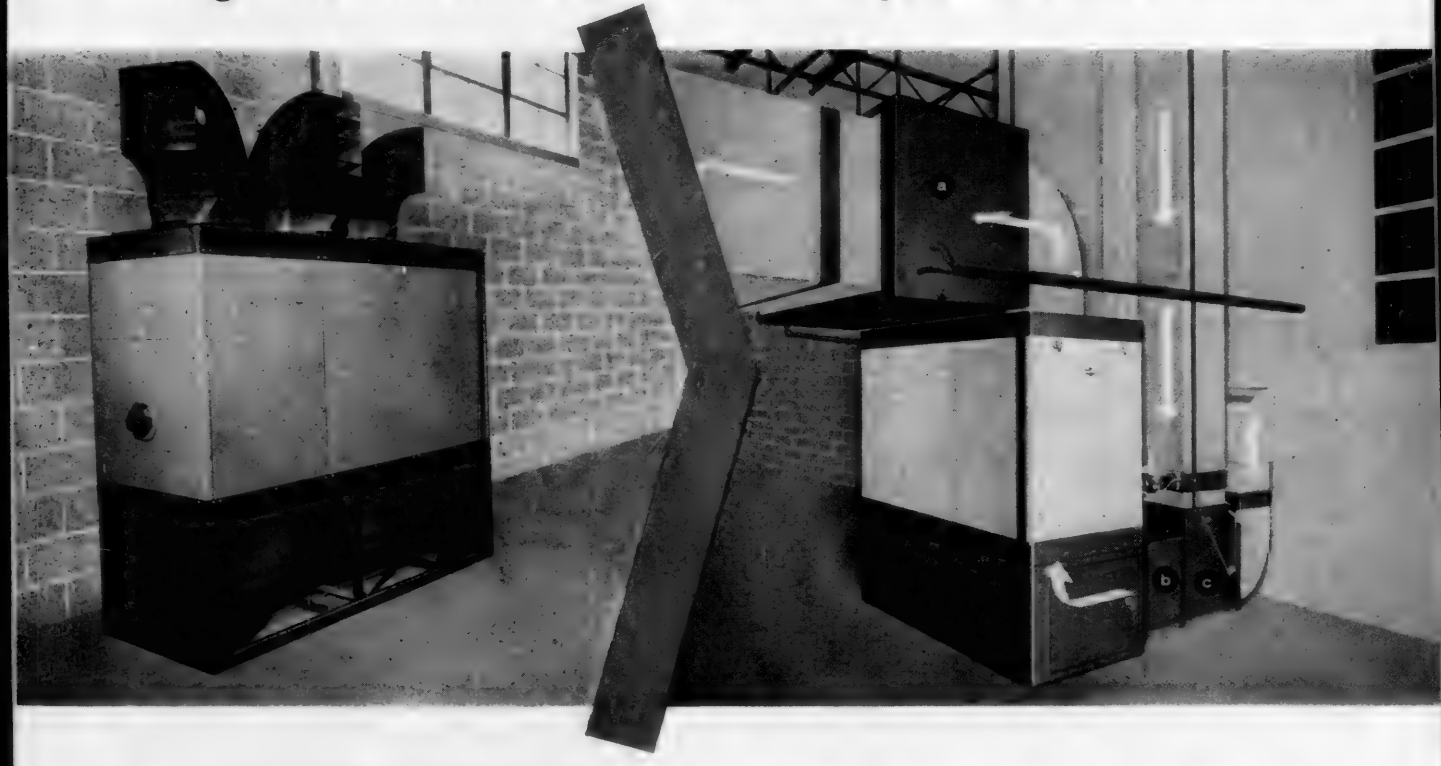
3217 North Pulaski Road — Chicago 41, Illinois

New from **LENNOX**

W-
This is great.
We installed these recently.
Management still amazed
at production increase.
J. W.

factory cooling

...using direct-fired heaters as your basic units



1. LENNOX DIRECT-FIRED SPACE HEATER—THE BASIC UNIT

Here's the unit you start with—the highly efficient Lennox OG4 industrial heater (gas, oil or combination). Absolute simplicity of design allows this stainless and aluminized steel unit to be applied in an upright, inverted or horizontal position. It can be installed for heating and ventilating needs now, with cooling easily added at a later date. Or, if you prefer, include the cooling coil in the initial installation.

2. ADD LENNOX COOLING COIL FOR YEAR 'ROUND PLANT COMFORT

Here you see how the cooling section (a), filter section (b) and mixing damper for outdoor air and return air (c), combine with the OG4 heater to provide year 'round cooling, heating and ventilating. The mixing damper can be controlled manually or automatically. Never before has an all-purpose line incorporated such versatility, ease of installation and maintenance, together with extreme efficiency and adaptability to widely varying heating, cooling and ventilating requirements.

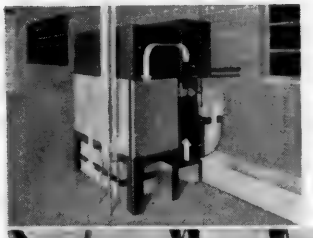
For further information and a Lennox cooling survey (at no obligation), write LENNOX, 615 S. 12th Ave., Marshalltown, Iowa.

...increases factory production up to 28%

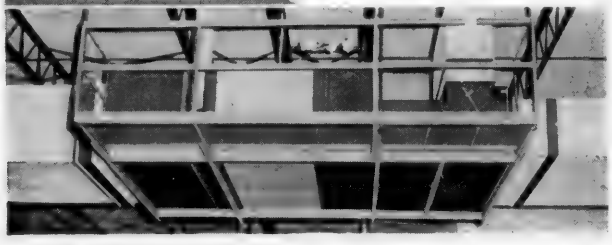
Air conditioning is justified if it only increases production 1½% to 3%

The benefits gained from factory cooling can, in most cases, make it a necessity. No one would expect employees to work in a cold building during the winter, so how can they be expected to work at full capacity in a hot one during summer? Once the advantages are weighed, factory cooling usually gains an overwhelming vote of approval from management. And, once *you* compare Lennox equipment with any other line, you'll see the reasons for the big switch to Lennox in industrial heating, cooling and ventilating.

MANY WAYS TO APPLY



Combined here are a Lennox down-flo OG4 central furnace, a cooling section, a filter section and a mixing damper for return and fresh air. The unit feeds a distribution perimeter loop buried in the concrete floor.



In this factory the OG4 has been combined with an evaporator section, filter section and damper for return and fresh air. It is suspended and has a service platform. This package closely controls temperature, humidity and make-up air all year.

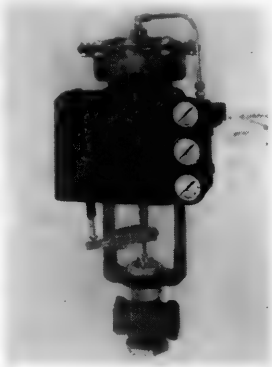
Don't be satisfied with less than

LENNOX

HEATS • COOLS • TREATS AND MOVES AIR

LENNOX INDUSTRIES INC., FOUNDED 1895 — MARSHALLTOWN AND DES MOINES, IOWA; COLUMBUS, OHIO; SYRACUSE, NEW YORK; DECATUR, GEORGIA; FT. WORTH, TEXAS; SALT LAKE CITY, UTAH; LOS ANGELES, CALIFORNIA. LENNOX INDUSTRIES (CANADA) LTD. — TORONTO, MONTREAL, CALGARY, VANCOUVER, WINNIPEG.

Versatile Valve Positioner



The Precisor valve positioner based on the force-balance principle is introduced by Taylor Instrument Companies, Rochester, N. Y. Not only is the 100N Series positioner a rugged, compact and economical instrument, but its several optional accessories lend desirable versatility to its applications. It may be used either as a simple controller or as a position-indicator - transmitter in addition to its prime function of providing faster, more positive, response for diaphragm actuators.

Reported by the company to provide excellent linearity between controller output pressure and the resulting valve stroke, the new instrument may be used with either a direct- or reverse-acting response. Field adjustments and calibration procedures may be performed with just a screwdriver and a wrench.

More Information? Circle Item 77 on Inquiry Card.

New Refrigeration Drier

A new in-line refrigeration drier with very high filtering and drying capacities, and specially built to withstand rough handling, is introduced by Ansul Chemical Co., Marinette, Wis.

Known as the System Boss, the drier is the product of seven years of Ansul research on refrigerant filtering. In line with findings that filter capacity is related more closely to filter material than filter area, the capacity of this unit can be more than 100% greater than ordinary driers, the firm reports. Its exact filter capacity depends on refrigerant flow rate.

There is no by-passing at all in the System Boss because the drier's fiber glass inlet pad, when full, will allow additional solids to go on to a Dutch Twill fiber glass unitized outlet filter. Because of the no by-passing feature, it is not necessary to have a screen on cap tube systems ahead of the drier.

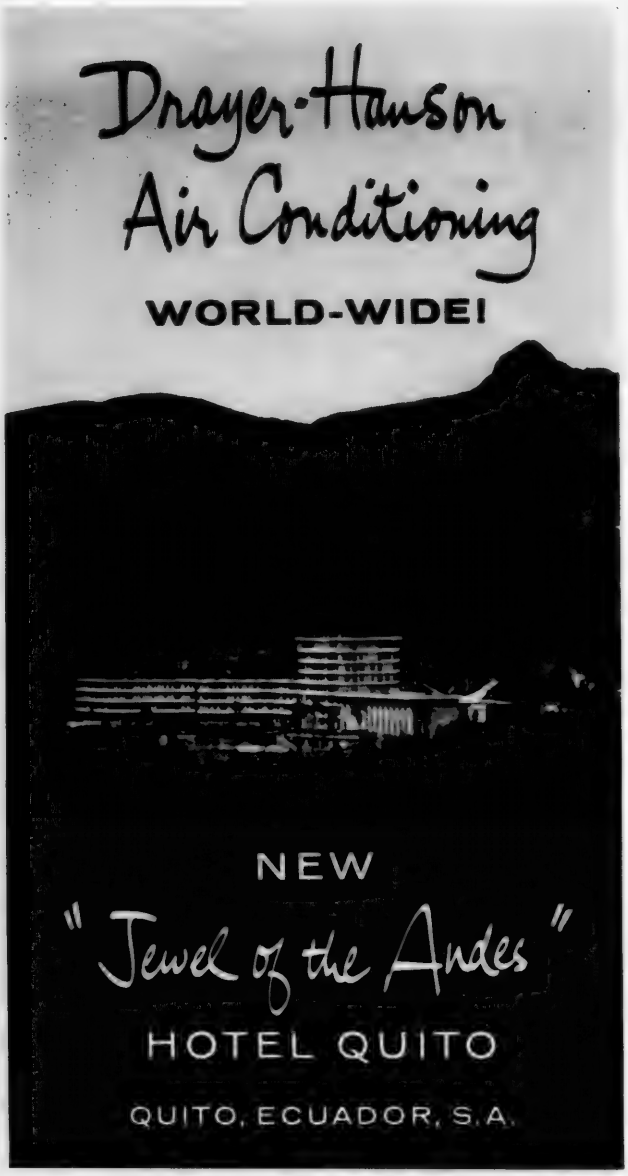
More Information? Circle Item 78 on Inquiry Card.

Rubber Expansion Joints

United States Rubber Co., New York, N. Y., introduces a rubber expansion joint that provides the same flexibility, but 60% more capacity for withstanding high working pressures than standard joints now on the market.

It is called the AMR (anti-migration rubber) expansion joint because of its unique inner construction that enables the metal re-enforcing rings to remain stable under pressure.

More Information? Circle Item 79 on Inquiry Card.



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CREDITS: ARCHITECT: Charles F. McKirahan, Ft. Lauderdale, Florida. AIR CONDITIONING CONTRACTOR: Josueth Gonzalez, Quito, Ecuador. D-H INTERNATIONAL SALES REPRESENTATIVE: Climate Control International, Inc., Los Angeles

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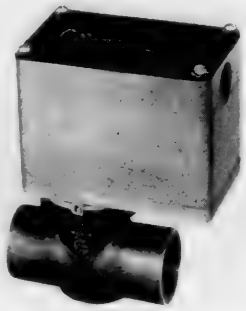
Motor Operated Zone Valve

A thermostatically controlled, motor operated hydronic zone valve, described as the VM-120 for control of water or steam in residential and light commercial heating or cooling systems, is introduced by General Controls Co., Glendale, Calif.



According to the manufacturer, this zone valve is a low voltage wing type for installation at the radiator or in the supply piping to the zone to be controlled. Its compact design permits easy installation between rafters and joists or in convectors.

Other features are synthetic packing which provides protection against leakage, and a quiet, powerful 24-volt electric motor requiring no lubrication. It can be opened or closed manually if power fails, and the operating control will automatically take over when electric power is restored.

More Information? Circle Item 80 on Inquiry Card.

Display Fountains

The decorative display fountain, once thought of only in connection with parks and public building sites, has caught the private homeowner's eye as an addition to his garden or outdoor living area.

A new type of fountain head, introduced by Rain Jet Corp., Burbank, Calif., has a unique rotating and wobbling pendulum action that produces an unusually effective display. Unlike ordinary fountains that discharge their water in a solid or continuous stream, this fountain head produces tiers of bursting droplets that look, according to the company, like "showers of sparkling diamonds, floating in space."

Once installed, the fountains require little maintenance and the operating cost is negligible, since the fountains utilize the same water over and over again by using a catch bowl or basin and recirculating pump.

More Information? Circle Item 81 on Inquiry Card.

Chemical Feeder

The Glaspump chemical feeder developed by California Scientific Glass Co., El Monte, Calif., is designed to pump chemical treatment into cooling towers, evaporative condensers or other unpressurized water systems to control and prevent development of algae and other bacteriological formations, thus maintaining a clean, free flowing water system.

More Information? Circle Item 82 on Inquiry Card.

Mobile Vertical File

Responding to the demand for a sturdy mobile file for drawings and prints, Plan Hold Corp., South Gate, Calif., announces a new model called the Mobile Plan Rack. It has a tubular steel frame and is equipped with ball bearing casters.

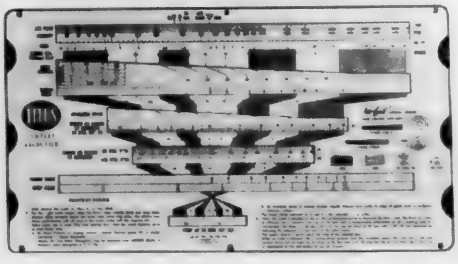
This mobile file can be adjusted to accommodate sheets up to 36 x 48 inches. It is intended for use with 12 Plan Hold Type "S" binders and provides filing space for up to 1200 sheets. It weighs less than 18 lb, and occupies only 3 sq ft of floor space.

More Information? Circle Item 83 on Inquiry Card.

Outlet, Air Flow Calculator

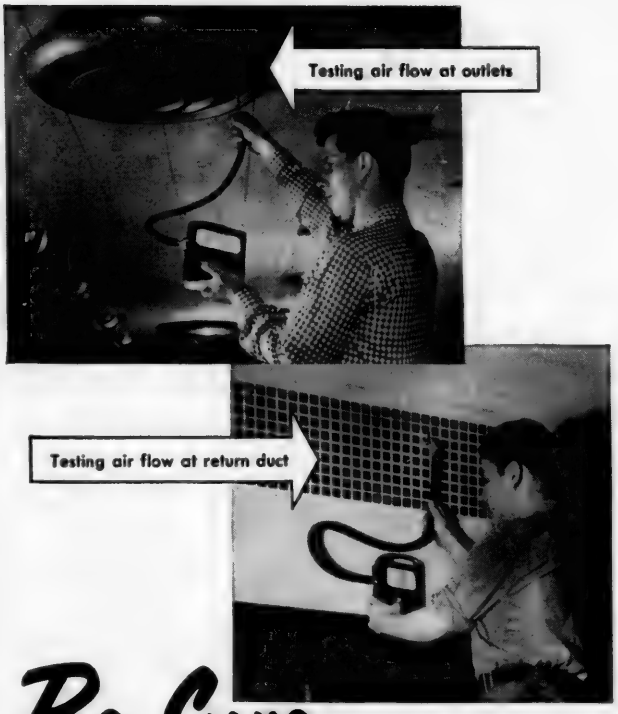
A handy, 3-slide rule that enables heating and air conditioning engineers to quickly and accurately determine outlet and size, and air flow, has been developed by Titus Manufacturing Corp., Waterloo, Iowa.

Slide rule was designed by Harold Straub, P.E., director of the Titus Research Laboratory. It is based on over five years of research in the laboratory, during which time comprehensive data was compiled on outlets with discharge patterns ranging from straightflow sidewall grilles to full circular patterns from ceiling diffusers. The correlation of this information provided not only a procedure for obtaining slide rule factors for all grilles and diffusers, but also for the first time brings together the theory on the performance of both isothermal and cooled horizontally projected air streams.



One side of the rule is an air flow calculator and the other side is an outlet selector. The air flow calculator makes it simple to determine the air flow rate for any diffuser or grille from velocity measurements in the field. It can be used for all anemometers and their factors. The outlet selector on the slide rule provides a simplified way to quickly determine outlet and size based on available space and noise criteria. It also provides complete throw, drop, and performance of outlets for heating, cooling and ventilating.

The slide rule costs $2.50, and it is available from Titus representatives, or by writing Titus Manufacturing Corp., Waterloo, Iowa. It is furnished complete with a 24-page instruction booklet.



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INDUSTRIAL PRESS AWARDS

(Continued from page 12)

Toledo; Gerald A. Dinneen, University of Utah; James B. Piper, The University of Wisconsin; Franklin Shifrar, The University of Wyoming; Shelton Johnson, Jr., Vanderbilt University; Robert L. Fink, Villanova University; Thomas C. Doan, Washington State University; James T. Anderson, West Virginia University, and Donald C. Root, Worcester Polytechnic Institute.

THERMOELECTRIC FREEZER DESIGNED FOR MASS MARKET

Stockholders at Welbilt Corporation's Annual Meeting in Maspeth, Long Island, N. Y., were shown the first prototype thermoelectric refrigerator-freezer developed by the company's electronics development laboratory. In a demonstration of a new portable thermoelectric refrigerator-freezer, Alexander P. Hirsch, Board Chairman, said it was the first of a group of appliances planned for the consumer market.

The 1½-cu ft refrigerator has a freezer compartment holding two ice cube trays of two-pound capacity. According to the company, the unit has three times the refrigerator capacity of existing thermoelectric commercial units developed to date. Mr. Hirsch said that Welbilt is planning to produce the prototype unit in quantity for dealer distribution by 1962, at prices competitive with compressor type equipment.

Extracts from Some of Fifteen Papers Presented at ASHRAE Annual Meeting

Fifteen comprehensive papers covering diversified subjects were presented at four technical sessions at the 68th Annual Meeting of American Society of Heating, Refrigerating, and Air-Conditioning Engineers, June 26-28, in Denver. Extracts from some of these follow:

A new development in steam vacuum refrigeration was discussed by Elliot Spencer, sales application engineer, Graham Manufacturing Co., Inc., Great Neck, N. Y. He pointed out that steam vacuum refrigeration, one of the oldest forms of water chilling devices, is characterized by substantial condenser water requirements which has limited applications to installations accessible to rivers or other inexpensive water sources.

Substitution of an evaporative steam condenser in which both the flash vapor and motive steam are condensed directly, rather than in a water cooled condenser, permits closer approach to prevailing wet-bulb conditions at all times and results in peak steam consumption, similar to that of competing systems.

At reduced load, and when the wet-bulb is below design conditions, steam consumption is reduced. A 5-deg F condensing temperature reduction corresponds to approximately 10% reduction in steam consumption.

Since the entire system is located outdoors, machine-room requirements are eliminated. The system may be located where cooling towers are presently installed. Appearance, design and size are similar to that of cooling towers for systems of similar capacity.

A careful weighing of all cost factors indicates competitive owning and operating costs. Lack of moving parts and simplicity of cycle are favorable to low maintenance and service costs.

In *a thermodynamic investigation of a refrigerant expansion engine*, a paper by Thomas M. Olcott, senior propulsion engineer, Convair, Fort Worth, and Harold A. Blum, professor, Mechanical Engineering Department, Southern Methodist University, Dallas, it is said that the principle of substituting a refrigerant expansion engine for the expansion valve of a vapor compression cycle system is well known. A search of the literature, however, reveals no published data on the performance of such an engine.

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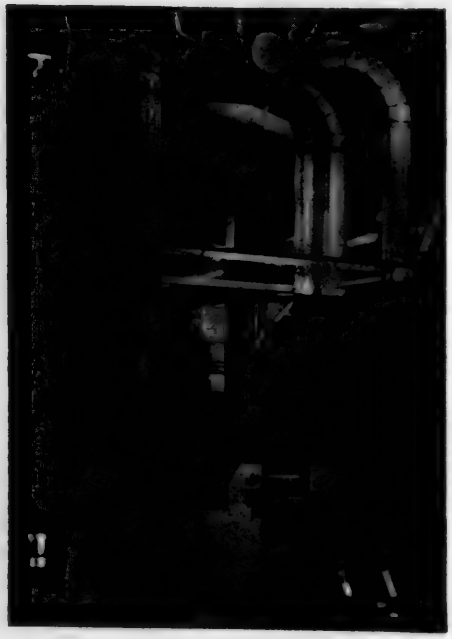

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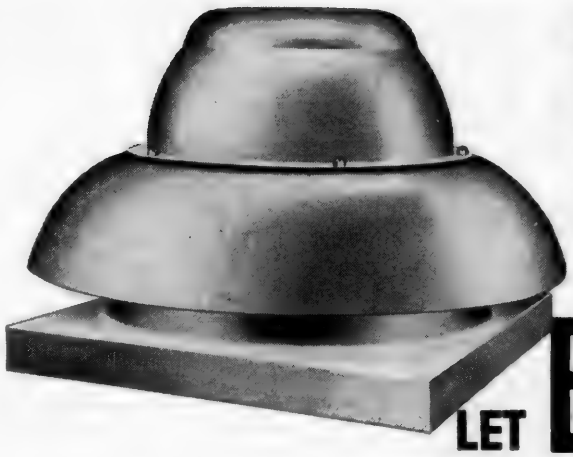
A simple engine was built, tested, and its performance compared with the isentropic expansion. The device did illustrate the above-mentioned principle; however, recovery of available energy was only as high as 10%, due primarily to pressure drop and leakage in the valves. If these were eliminated recovery could have reached 40%.

A theoretical comparison was made between the single circuit refrigeration system, employing the expansion engine, the cascade system, and the multi-stage compression system.

Some strength characteristics of ice at the interface was discussed by J. K. Stene, associate professor of mechanical engineering, Purdue University, and W. E. Fontaine, professor of mechanical engineering, Purdue, and director for engineering research, Ray W. Herrick Laboratories. Because ice that forms on a surface must be removed economically in order for the surface to be useful commercially, and ice forms on most cold surfaces where water is present and must be removed to enhance heat transfer to or from the surface, experiments, described in this paper, were undertaken to determine some strength characteristics of the solid-ice interface.

The paper, *heat and mass transfer in dehumidifying surface coils,* by William L. Bryan, associate professor, Department of Mechanical Engineering, Case Institute of Technology, contains experimental results for transfer of mass and heat by a bare surface coil under conditions of measured surface temperature. Data were given for the heat transfer coefficients, for the mass transfer coefficients and for experimental surface temperatures of the dehumidifying coil.

A simple fundamental equation is presented for the actual surface temperature of the coil and the locus of air states through the coil. Attention is given to the fundamentals in present methods of coil calculations relating to the



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LO-HYT GRAVITY	Gravity	AS REQUIRED	18	18	Downward
MONITOR	Gravity	MADE TO ORDER		1	Upward
MONOVENT (Ridge)	Gravity	48 to 5,184	15	15	Upward
REVOLVING	Gravity	123 to 10,931	17	17	Sideward
STANDARD GRAVITY	Gravity	35 to 24,890	19	19	Upward
THERMAVENT	Gravity	MADE TO ORDER		2	Upward
CENTRIFLOW	Power	65 to 36,430	56	184	Downward
FREE EXHAUST FAN	Power	5,000 to 75,550	7	17	Upward
FREE FLOW FAN	Power	1,040 to 99,050	15	35	Upward
LOW TYPE	Power	337 to 47,400	15	60	Downward
STANDARD FAN	Power	685 to 15,000	10	10	Upward

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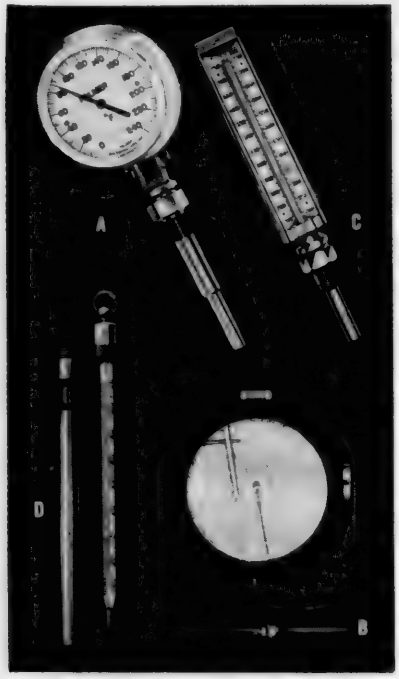

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actual coil surface temperature.

In a paper on *refrigerating capacity and performance data for various refrigerants, azeotropes and mixtures*, R. C. McHarness and D. D. Chapman, Engineer, Freon Products Laboratory (du-Pont) report on calorimeter tests performed on single refrigerants and on a variety of mixtures to determine how the cooling capacity of one refrigerant is affected by the addition of a second one. Various operating data, such as coefficient of performance, compression ratio, suction and discharge temperatures and pressures, and power requirements, have been obtained during the respective runs and are given.

Solar heat gains through plastic domed skylights were measured by L. F. Schutrum, ASHRAE Research Laboratory, and N. Ozisik, Oak Ridge National Laboratory. Data are given for the August 1 design day for a number of skylights and K-factors and U-values are given from which the solar and total heat gains can be found for any location and time of the year.

Air infiltration through revolving doors was investigated by Mr. Schutrum, C. M. Humphreys, and J. T. Baker, of the ASHRAE Research Laboratory, and Mr. Ozisik. Total infiltration was found to have two components: that related to door speed and that through door cracks. Air-infiltration rates associated with door revolution are separated from the total and given as a function of door speed and indoor-outdoor air temperature difference. An analytical solution was developed to calculate this component.

Air infiltration through door cracks was a function of indoor-outdoor pressure difference and the crack size. Traffic patterns and the average door speeds were investigated in the field with manually operated revolving doors, and air infiltration rates corresponding to typical traffic rates were computed.

Calculated temperature rise in round ducts by J. Richard Wright, Tennessee Polytechnic Institute, Cookeville, Tenn., and Edward J. Brown, University of Illinois, were: (1) duct sizes: 4-8-in. diam; (2) entering air temperature: 50-70 deg F; (3) duct air velocities: 400-1200 fpm; (4) insulation thickness: 0, 1 in., 2 in.; (5) ambient temperature: 75-150 deg; (6) surface emissivity: 0.25 for uninsulated ducts, 0.05 (al. foil) and 0.90 (duplex paper) for insulated ducts.

I-B-R RESEARCH SHOWS VALANCE HEATING BELOW PAR

The results of I-B-R's research on the valance system, finned tube elements designed for installation at the ceiling to both heat and cool hydronically, were presented to the membership of The Institute of Boiler and Radiator Manufacturers at its Annual Meeting on June 14, 1961. Professor Warren S. Harris, who supervises I-B-R research, stated that heating performance of the valance system was not, in its present form, as satisfactory as cooling performance demonstrated during the summer of 1960.

At the November, 1960, meeting of I-B-R, a progress report was made on cooling with the valance system, and at that time the membership was advised that the valance system was the most satisfactory hydronic cooling system that had been investigated by I-B-R. (See News of the Month, *Air Conditioning, Heating and Ventilating*, December, 1960.)

The construction and style of a house have distinct effects upon the performance of heating and cooling equipment. The I-B-R hydronic research house was purposely designed to be difficult to heat and cool, to bring out the weaknesses of the systems installed and to find ways to correct such weaknesses. The I-B-R House has a minimum of insulation and is operated without storm sash. Under these conditions potential weaknesses in the operation of the heating and cooling systems are amplified.

Like Ceiling Panel System

While the results of the winter operation have not been completely analyzed, it is apparent that the valance system has much the same operating characteristics as a ceiling panel system. There were warm floor surface temperatures and fairly uniform air temperatures in the living zone. The cost of operation was about the same as a ceiling panel system, which is approximately 20% more than a hot water system using baseboards, convectors or radiators.

However, during periods of low outdoor temperatures, there was a noticeable movement of cool air across the floor in rooms having large glass areas which were not protected by storm sash. Inherent in all systems in which the same room units are used for both heating and cooling is the maintenance of proper room temperature balance throughout the year. With the installation in the I-B-R house, the bedrooms on the third (upper) level were a little warmer during the heat of the day in the summer, and the rooms on the first (lower) level were underheated in cold weather.

Research Continues

I-B-R will continue its research on a valance system designed basically for cooling, augmenting it with some baseboard located under large glass areas and in rooms where the valance required for cooling may not be adequate to take care of the entire heating load. The objective of I-B-R's research is to find a combination of heating-cooling hydronic system which will be in near-perfect balance throughout the year, have as good or better operating characteristic as systems previously tested, and be one which can be made available at moderate cost.

A University of Illinois Engineering Experiment Station Bulletin containing a complete report of the tests made during the summer of 1960 and the winter of 1961 will be available for distribution in 1962.

(Please turn page)

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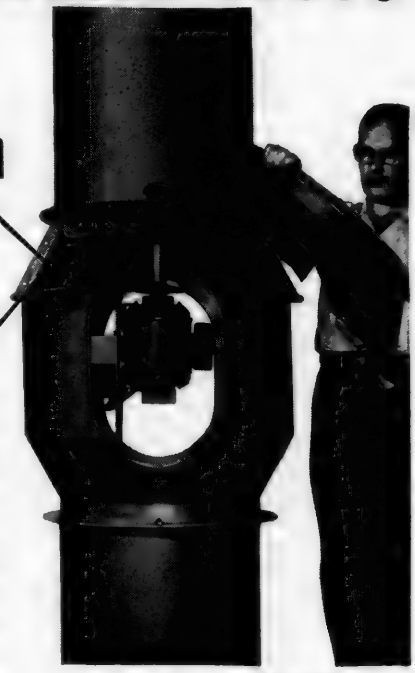

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HYDRONICS NOW IN DICTIONARY

Introduced four years ago as a new term for the hot water heating industry's products and services, "hydronics" is listed on page 713 of the latest edition of *Webster's New World Dictionary*.

Two definitions relating to hydronics are listed as follows:

hy.dron.ic (hi-dron'ik), adj. of or having to do with hydronics.

hy.dron.ics (hi-dron'iks), n. pl. (construed as sing.), (hydr electronics), the science of dealing with electrically controlled systems for heating, cooling, etc., by the forced circulation of liquids or vapors.

The new term was first proposed by an I-B-R committee in June, 1957. Until that time, the industry suffered from a profusion of terms, including "wet heat," "liquid heat" and "fluid heat."

INTERNATIONAL CONFERENCE

An International Conference on Heating, Ventilating and Air Conditioning, organized by The Institution of Heating and Ventilating Engineers in cooperation with other British organizations has been announced. It will be held in London, September 27 to October 4, 1961, in London and will coincide with an International Exhibition of the British Heating, Ventilating and Air Conditioning industry.

Engineers from all over the world who are engaged in the specialist field of heating, ventilating and air conditioning are welcomed. The sessions are grouped around three themes. These are: administrative advances likely in the next ten years; technical advances likely in the next ten years; and integrated design of architectural and engineering services for economy of building construction.

In addition to the papers, a program of technical visits has been arranged, linked to the three themes of the Conference. For further information, write Conference Secretariat, Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, S.W. 1.

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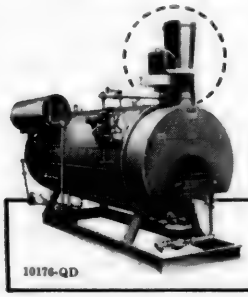
British 802,920
Canadian 593,817
Other patents pending



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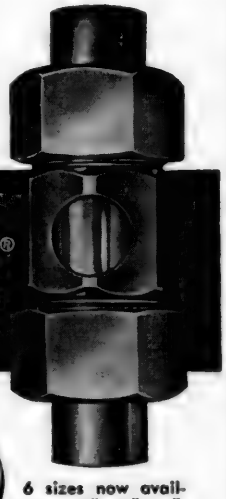

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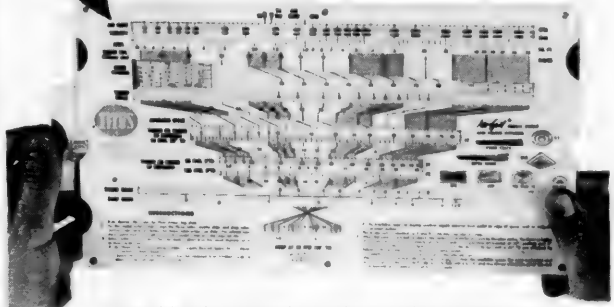
- preformed copper extension eliminates need for separate gaskets—*foolproof* installation.
- complete, self-contained, economy unit.

Write today for catalog E-57 covering the complete Allin line.

Allin
ALLIN MANUFACTURING CO.
410 N. Hermitage Ave. • Chicago 22, Illinois
Over 1,000,000 Liquid Eyes Sold to Date!

NEW TITUS SLIDE RULE

Combination Outlet Selector & Air Flow Calculator for ENGINEERS & CONTRACTORS



One side of this handy, 3-slide precision instrument is an *OUTLET SELECTOR* to quickly determine outlet and size based on available space and noise criteria. Other side of rule is *FLOW CALCULATOR* to determine air flow rate for any diffuser or grille from velocity measurements in the field.

Developed by H. Straub, P.E., Director of Titus Research Laboratory. Based on over 5 years of research. 6" x 11" in size. *Furnished complete with 24-page Instruction and Information Booklet for $2.50.*

MAIL COUPON WITH $2.50 TODAY

TITUS MFG. CORP., WATERLOO, IOWA
Please send Titus Slide Rule complete with instruction booklet. Enclosed is my check for $2.50.
NAME _____
ADDRESS _____
CITY _____ STATE _____

It's NEW for HEAVY-DUTY SEWAGE USES

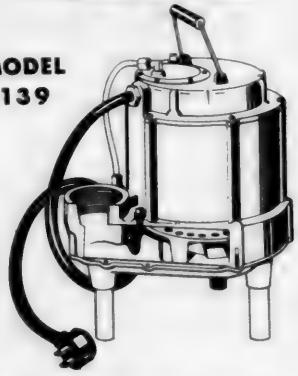
KENCO®

HIGH CAPACITY 8600 GPH at LOW HEAD 5 ft. Head

6800 GPH at 10-ft.

PUMP

MODEL 139



- Completely Submersible
- Rugged Cast-Bronze Construction
- Extra-Deep 2-Vane NON-CLOG Impeller
- 2" NPT Discharge
- Extra Powerful Pumping Action
- Shreds sewage and other solids for dependable non-clog performance
- Leg supports—threaded to use any standard ½" pipe for readily adjustable stand

See Your Wholesaler

A-3000A

KENCO PUMP

Division of The American Crucible Products Co

BRIEFLY STATED NEWS ITEMS

Producers' Council, Inc., has chosen the Engineering Handbook published by LENNOX INDUSTRIES, INC., for the group's Certificate of Merit. The Handbook was cited in a competition judged by members of Consulting Engineers Council. Conducted in four different literature classifications, the contest in which the Lennox award was won was in Class II which covers "literature offering technical information relating specifically to a product or products of a single manufacturer." No other company in the heating and air conditioning industry qualified for an award.

ENGINEERS AND CONTRACTORS

W. H. Buchhagan, president of BUCKNELL ENGINEERING CO., consulting engineers of Pittsburgh, Pa., has been elected a member of the Board of Directors of Consulting Engineers Council as well as president of the Pennsylvania Association of Consulting Engineers at the latter's annual meeting in Philadelphia. . .

Joe Herman, president of J. HERMAN CO., INC., air conditioning contractors in Los Angeles, was appointed a member of the Industrial Safety Board by Governor Edmund G. Brown of California. Mr. Herman, a past president of the Mechanical Contractors Association of Southern California, is serving his second term as president of the Los Angeles City Fire & Police Pension Board.

Professor Norman Parker, head of the Department of Mechanical Engineering, has been appointed vice-president of the UNIVERSITY OF ILLINOIS in charge of the Chicago Undergraduate Division. He will supervise expansion of the present two-year division into a four-year institution. Active administration of the ME department is being carried out by Professor Seichi Konzo, who was appointed Acting Head until a successor to Professor Parker is selected. . .

J. A. Elzi, M. C. Westrate, and C. E. Asbury have been elected vice-presidents; while C. H. Alban and E. Weatherly, Jr. have been named directors of COMMONWEALTH ASSOCIATES, INC. J. A. Meader, an architect, was elected assistant secretary. Mr. Elzi will continue as director of engineering administration, and Mr. Westrate as treasurer and chief consulting engineer. Commonwealth Associates Inc. is the consulting engineering affiliate of Commonwealth Services Inc., New York management and engineering consulting organization.

SOCIETIES AND ASSOCIATIONS

Stephen F. Dunn, president of National Coal Association, was reelected president of NCA's affiliate, BITUMINOUS COAL RESEARCH, INC., Pittsburgh, Pa. Also reelected was James R. Garvey, vice-president and director of research. At NCA's 44th Anniversary Convention in Washington, a telegram was received from President Kennedy praising the bituminous coal industry as "an outstanding example of the ingenuity and talent available in America." . .

ASHRAE will donate its controlled environment facility to the Environmental Research Center at Kansas State University. According to BRI publication *Building Science News*, this is the Society's first major decision regarding its research activities since its December announcement of an expanded grants-in-aid program to colleges and private laboratories, and the closing of its own laboratory in Cleveland. . .

Rixford A. Beals was named manager of the Commercial and Industrial Division, NATIONAL BETTER HEATING-COOLING COUNCIL, New York, N. Y. He is a former editorial director of American Institute of Mining, Metallurgical and Petroleum Engineers.

Glenn P. Bakken was reelected president of COPPER & BRASS RESEARCH ASSOCIATION, New York, at CABRA's 39th Annual Meeting

at The Homestead. Mr. Bakken is president of Chase Brass & Copper Co., Inc.

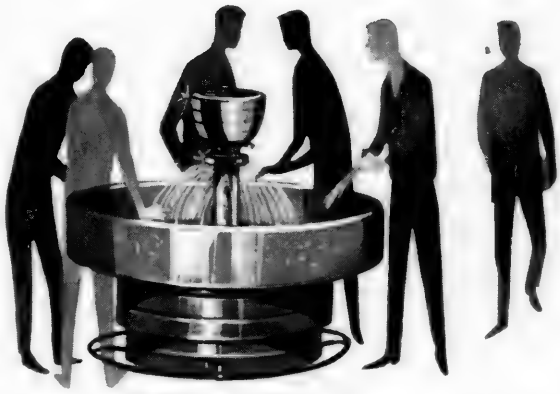
BURGEONING BUSINESS

A joint announcement has been made by William B. Clements, president, FRICK COMPANY, and Maurice Parker, board chairman, Wilson Bros., that an agreement has been signed calling for Frick's Pennsylvania-Bradford Appliance Division to purchase substantially all the assets of Lawson Mfg. Co. and its Hoffman Water Heater Division in Louisville, Kentucky. The combination will make Pennsylvania-Bradford, already a well-known manufacturer of water heaters, a major factor in the domestic and commercial water heater field, with sales upwards of $10 million annually, it was said.

Effective December 31, 1961, American-Standard Industrial Division will no longer market Nesbitt School Products. The arrangement under which American-Standard promoted and sold this equipment is being terminated by mutual agreement. The arrangement had been in effect since 1927. . .

STAMFORD FAN COMPANY has been organized to manufacture and sell a complete line of commercial and industrial fans and blowers. President of the new company is Walter Fleming, who has been associated with fan manufacturing for 35 years. Associated with the new company is Sedgwick Machine Works, Inc. of Poughkeepsie, N. Y. Research, design and manufacturing of the new line will be conducted at the Poughkeepsie plant. Sales and sales engineering will be handled at the Stamford office, 47 Cedar Street, Stamford, Conn. Products of the new company will include centrifugal blowers, mill exhausters, roof fans, line flow cabinet blowers, exhaust fans, propellor fans, gravity ventilators and induced draft fans. Catalogs and specification sheets on the entire line will be available for industrial distribution in the immediate future. . .

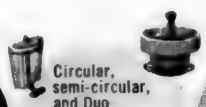
(Concluded on page 126)



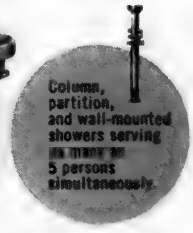
Why the big swing to Bradley Washfountains? Because only Washfountains please your clients in all these important ways: They cut installation costs 50% or more. They save an average of 25% in floor space. They eliminate disease transmission by germ-laden faucets and dirty bowls. Washfountains save maintenance man-hours and expenses . . . save water . . . and significantly speed traffic flow. For these reasons, *Washfountains gain in popularity with every passing day.*

Bradley Washfountains are available in precast stone (Granito), precast marble (black and white, sage green, and vari-colored), in stainless steel, and in vitreous enamel (forest green, mint green, sky blue, white, sun tan, citrus yellow). Sizes 54" circular and semi-circular, 36" circular and semi-circular. Heights: Standard — 29¼" . . . Junior — 25¼".

Bradley



Circular, semi-circular, and Duo Washfountains serving as many as 8 persons simultaneously.



Column, partition, and wall-mounted showers serving as many as 5 persons simultaneously.

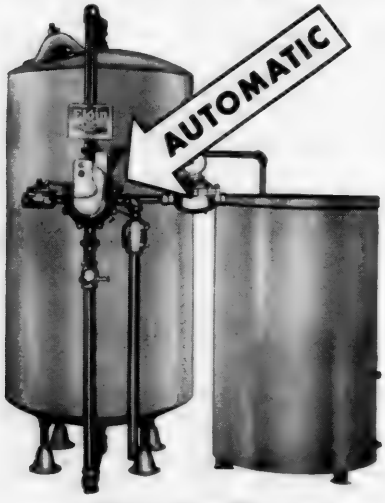
Bradley Washfountains and Showers provide group facilities for as many as 8 and 5 persons, respectively . . . in schools and in commercial, industrial, and public buildings. For additional information, contact your Bradley representative. Or write for Publication No. 6004. Bradley Washfountain Co., 2352 W. Michigan Street, Milwaukee 1, Wisconsin.

New!

SERIES 500

ELGIN

WATER SOFTENER



Elgin Quality at Amazingly Low Price!

Here is your final answer for those commercial jobs where water softener dependability is a must, but price is often a deciding factor.

In the new Elgin 500 series you have a fully automatic water softener that truly offers that traditional Elgin quality at an amazingly low price—a value that only Elgin's 50 years of experience could make a reality.

It is the kind of product that you can stand squarely behind—a product designed and built down to the last detail to do its job day after day with an absolute minimum of servicing. Above all it is:

EASY TO SIZE
EASY TO INSTALL

Series 500 softeners are also available in manually operated models. At their still lower price, they register a new high value in the manual type of softener.

Get the complete story
Write for bulletin

ELGIN SOFTENER CORPORATION

153 N. Grove Ave., Elgin, Illinois
Representatives in Principal Cities
In Canada: G. F. Sterne & Sons, Ltd., Brantford

UNITED STATES DEGREE

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING'S 33rd Year of Publication of Monthly Degree-Day Data

City	May			Season to May 31 from Sept. 1		
	1961	1960	Normal	1961	1960	Normal
Abilene, Tex. (A)	10	40	0	2650	3048	2707
Albany, N. Y. (A)	314	152	246	7173	6602	6888
Albuquerque, N. M. (A)	65	82	70	4321	4286	4389
Alpena, Mich. (C)	508	370	437	8288	8321	7803
Anchorage, Alaska (A)	526	483	598	9967*	9671	9920
Asheville, N. C. (C)	169	181	105	4298	4507	4067
Atlanta, Ga. (A)	66	71	20	3092	3226	2826
Atlantic City, N. J. (C)	290	157	189	5449	4731	4717
Augusta, Ga. (A)	17	35	0	2666	2830	2138
Baltimore, Md. (C)	113	84	73	4436	4263	4203
Billings, Mont. (A)	(a)	287	304	(a)	7015	6959
Binghamton, N. Y. (C)	299	189	240	6823	6013	6472
Birmingham, Ala. (A)	48	72	30	2822	3093	2788
Bismarck, N. D. (A)	344	290	355	8032	8870	8851
Block Island, R. I. (A)	415	298	335	5944	5447	5720
Boise, Ida. (A)	235	327	249	5235	6379	5798
Boston, Mass. (A)	287	166	236	5933	5448	5784
Buffalo, N. Y. (A)	385	235	315	7113	6550	6720
Burlington, Ia. (A)	231	187	179	6007	6593	6067
Burlington, Vt. (A)	454	147	307	8415	7495	7727
Cairo, Ill. (C)	81	97	47	4005	4344	3756
Charleston, S. C. (C)	5	5	0	2053	2203	1769
Charlotte, N. C. (A)	74	72	29	3484	3512	3205
Chattanooga, Tenn. (A)	57	129	45	3643	3864	3384
Cheyenne, Wyo. (A)	377	288	462	6883	7220	7317
Chicago, Ill. (A)	265	221	229	5964	6361	6252
Cincinnati, O. (C)	153	148	108	4581	4798	4532
Cleveland, O. (A)	341	265	223	6482	6108	5950
Columbia, Mo. (A)	184	129	135	4933	5628	5093
Columbia, S. C. (A)	15	38	0	2750	2936	2284
Columbus, O. (C)	227	189	153	5471	5495	5255
Concord, N. H. (A)	383	201	316	7581	6808	7462
Concordia, Kans. (C)	195	104	146	5147	6099	5303
Dallas, Tex. (A)	8	33	0	2327	2793	2272
Denver, Colo. (A)	299	245	286	5449	6216	6051
Des Moines, Ia. (A)	221	153	201	6302	7173	6384
Detroit, Mich. (A)	295	219	251	6254	6330	6336
Devils Lake, N. D. (C)	413	339	394	9218	10194	9695
Dodge City, Kans. (A)	154	123	135	4828	5639	5043
Dubuque, Ia. (A)	317	259	267	7113	7717	7159
Duluth, Minn. (A)	468	446	487	9011	9639	9217
El Paso, Tex. (A)	0	10	0	2820	2514	2641
Ely, Nev. (A)	454	447	418	6981	7542	7177
Escanaba, Mich. (C)	504	446	471	7036	8238	8334
Evansville, Ind. (A)	149	164	90	4685	5095	4354
Fairbanks, Alaska (A)	480	378	546	13828*	13306	13520
Fargo, N. D. (A)	375	276	338	8725	9326	9107
Fort Smith, Ark. (A)	46	62	24	3373	3815	3188
Fort Wayne, Ind. (A)	283	237	226	6280	6458	6217
Fort Worth, Tex. (A)	9	32	5	2455	2855	2361
Fresno, California (A)	57	54	43	2756	2392	2532
Galveston, Tex. (C)	0	3	0	1288	1573	1211
Grand Junction, Colo. (A)	127	156	145	5257	5753	5773
Grand Rapids, Mich. (A)	343	254	301	6675	6867	6948
Green Bay, Wisc. (A)	373	365	347	7674	8162	8062
Greensboro, N. C. (A)	100	112	50	4113	4247	3810
Greenville, S. C. (A)	56	87	32	3175	3542	3060
Harrisburg, Pa. (A)	204	171	128	5675	5243	5244
Hartford, Conn. (A)	302	164	201	6522	5914	6094
Havre, Mont. (A)	296	334	313	7113	8074	8030
Helena, Mont. (A)	354	446	399	6904	8172	8005
Houston, Tex. (C)	0	2	0	1344	1655	1276
Huron, S. D. (A)	341	259	279	8202	8710	7796
Indianapolis, Ind. (A)	268	214	176	5904	6027	5581
Jackson, Miss. (A)	37	49	0	2435	2861	2202
Juneau, Alaska (A)	538	470	558	7889*	7261	7892
Kansas City, Mo. (A)	179	86	111	4804	5361	4880
Knoxville, Tenn. (A)	114	108	50	3889	4027	3590
La Crosse, Wisc. (A)	272	196	250	7181	7557	7545
Lander, Wyo. (A)	348	322	396	7369	(a)	8110
Lewiston, Me. (O)	355	230	344	7488	6833	7662
Lincoln, Nebr. (C)	211	131	172	5685	6684	5826
Little Rock, Ark. (A)	44	64	18	3288	3541	2982
Los Angeles, Calif. (C)	61	24	68	859	913	1432
Louisville, Ky. (A)	193	151	94	4966	4742	4434
Lynchburg, Va. (A)	137	146	82	4487	4516	4148

-DAYS FOR MAY, 1961

City	May			Season to May 31 from Sept. 1		
	1961	1960	Normal	1961	1960	Normal
Macon, Ga. (A)	23	33	0	2185	2583	2049
Madison, Wisc. (A)	352	296	266	7334	7787	7181
Marquette, Mich. (C)	523	507	477	7998	8336	8184
Memphis, Tenn. (A)	70	69	24	3330	3589	3137
Meridian, Miss. (A)	41	59	9	2542	2890	2333
Milwaukee, Wisc. (A)	434	402	351	7157	7422	7044
Minneapolis, Minn. (A)	335	247	259	7389	8087	7748
Moline, Ill. (A)	242	203	199	6337	6907	6311
Montgomery, Ala. (A)	28	43	0	2463	2514	2137
Nashville, Tenn. (A)	98	121	43	3893	4223	3513
New Haven, Conn. (A)	307	214	261	6114	5510	5956
New Orleans, La. (C)	0	14	0	1187	1558	1175
New York (Central Park)	172	(a)	153	5041*	4805*	4981*
New York (International A)	199	125	(a)	5209*	(a)	(a)
New York (La Guardia A)	202	(a)	141	5037*	(a)	4979*
Newark, N. J. (A)	169	114	148	5309	4844	5241
Norfolk, Va. (A)	110	37	59	3713	3565	3454
North Platte, Nebr. (A)	314	242	243	6422	7378	6470
Oak Ridge, Tenn. (C)	105	141	58	3971	4210	4028
Oakland, Calif. (A)	242	174	212	2782	2373	2883
Oklahoma City, Okla. (A)	49	73	38	3551	4255	3519
Omaha, Nebr. (A)	188	119	175	5846	6896	6123
Parkersburg, W. Va. (C)	197	183	119	4970	5094	4737
Peoria, Ill. (A)	277	233	192	6309	6640	6035
Philadelphia, Pa. (C)	148	84	93	4672	4434	4523
Phoenix, Ariz. (A)	0	0	0	1370	1451	1492
Pittsburgh, Pa. (C)	244	173	137	5368	5179	5035
Pittsfield, Mass. (A)	393	252	336	7617	7125	7501
Portland, Me. (A)	427	321	394	7688	7046	7493
Portland, Ore. (C)	395	287	199	3508	4225	4046
Providence, R. I. (A)	302	196	258	6207	5718	6041
Pueblo, Colo. (A)	170	167	203	4631	6085	5682
Raleigh, N. C. (A)	83	87	29	3755	3868	3075
Rapid City, S. D. (A)	314	262	357	6465	7759	7331
Reading, Pa. (C)	178	142	123	5382	4970	5044
Red Bluff, Calif. (A)	90	91	51	2650	2476	2546
Reno, Nev. (A)	352	405	318	5630	6009	5783
Richmond, Va. (A)	106	88	66	4216	4211	3955
Rochester, N. Y. (A)	366	212	289	6920	6773	6766
Roswel, N. M. (A)	17	28	28	4080	3628	3424
Sacramento, Calif. (C)	111	73	85	2590	2335	2595
St. Joseph, Mo. (C)	185	107	101	5359	6119	4692
St. Louis, Mo. (C)	137	126	94	4433	5052	4462
Salt Lake City, Ut. (A)	183	222	233	5412	6142	5785
San Antonio, Tex. (A)	0	7	0	1552	1947	1579
San Diego, Calif. (A)	103	45	97	1096	1006	1513
Sandusky, O. (C)	274	204	217	5961	6028	5818
San Francisco, Calif. (C)	277	244	248	2594	2123	2523
Sault Ste. Marie, Mich. (A)	554	410	499	8718	8803	9016
Savannah, Ga. (A)	7	15	0	1991	2276	1710
Scranton, Pa. (A)	293	221	196	6895	6260	5994
Seattle, Wash. (C)	259	291	246	3948	4214	4237
Sheridan, Wyo. (A)	351	315	387	6775	7712	7674
Shreveport, La. (A)	15	23	0	2251	2742	2117
Sioux City, Ia. (A)	219	161	228	6605	7712	6933
Spokane, Wash. (A)	367	420	330	6300	7176	6661
Springfield, Ill. (A)	227	190	127	5647	6065	5211
Springfield, Mo. (A)	164	133	118	4620	5167	4669
Syracuse, N. Y. (A)	317	176	247	6914	6514	6454
Toledo, O. (A)	322	244	245	5619	6547	6322
Topeka, Kans. (C)	197	115	112	5162	5903	4906
Trenton, N. J. (C)	201	106	133	5339	4880	5057
Tulsa, Okla. (A)	70	88	44	3612	4195	3584
Utica, N. Y. (O)	177	149	253	5956	6142	6796
Valentine, Nebr. (A)	335	268	288	6907	7912	6971
Walla Walla, Wash. (C)	187	236	171	4380	5197	4810
Washington, D. C. (A)	123	103	80	4635	4293	4258
Wichita, Kans. (A)	128	97	101	4592	5197	4564
Williston, N. D. (C)	321	292	360	7901	9009	8859
Winnemucca, Nev. (A)	369	368	299	5009	6682	6241
Yakima, Wash. (A)	280	331	205	5616	6265	5785

a) Data not available.
* Includes July and August.
** Figures based on City office readings.

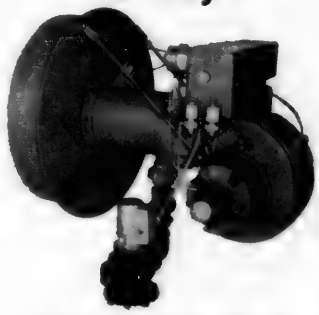
Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with two exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Deparmtent, Central New York Power Co., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively.

All New
Webster
DUAL FUEL
CYCLONETIC*
Burner

Superior

in any



Configuration

* TRADE MARK
Write for Literature

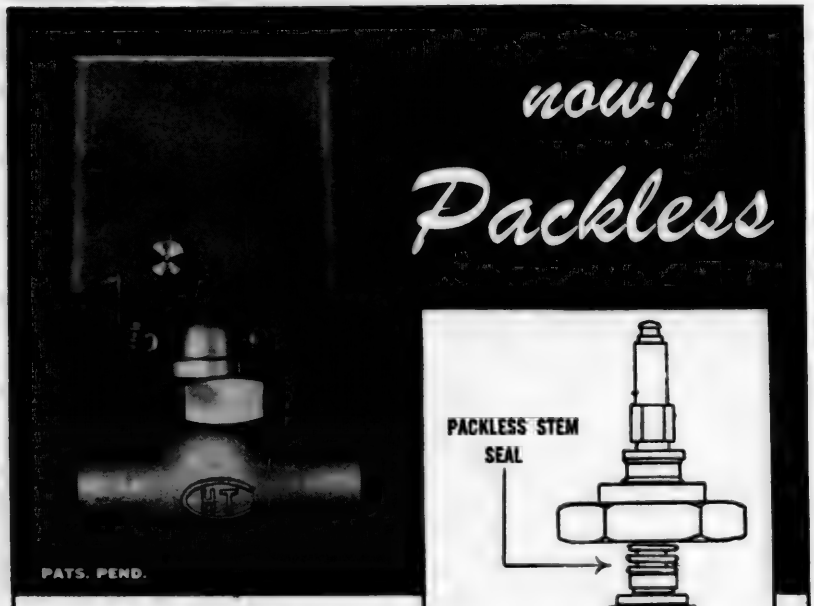
WEBSTER ENGINEERING
TULSA 9, OKLAHOMA
MR
a division of
Midland-Ross Corporation

Briefly Stated

(Concluded from page 123)

Stockholders of REPUBLIC-TRANSCON INDUSTRIES, INC. approved purchase of assets of The Mathes Company Division of Glen Alden Corporation. Mathes, located in Marble Falls, Tex., manufactures residential, commercial, and industrial air conditioning and heating equipment. Republic-Transcon manufactures gas and electric glass-lined water heaters, major home appliances, and other porcelain enamel products. Executive offices of the company are in Beverly Hills, Calif. . .

Substantially all the assets of Midwest Piping Co., Inc., St. Louis, Mo., were acquired by CRANE COMPANY, Chicago, Ill. Midwest will be operated as a division of Crane. Norman B. Champ, Jr., formerly vice-president and director of Midwest, has been elected a vice-president of Crane. He will supervise Midwest, Chapman Valve, Swartwout Division, from headquarters in New York City. Midwest, founded in 1896 as the Urbauer-Atwood Company, is one of the country's largest piping contractors, specializing in power plant and heavy industrial work.



ZONVALVE®

complete shut-off — no "seepage"

Engineers and heating men know—it's construction that tells the story! Zonvalve's packless design utilizes an electro tin-plated Phosper Bronze Bellows to assure a permanent stem seal.

Zonvalve is powered by a heavy-duty motor and power is transmitted by pinion spur gear and cam assembly.

Globe-type construction insures 100% shut-off. Positive temperature control because there is no heat waste through "seepage".

Zonvalve is easy to install—operates with equal efficiency when mounted in any position. Made in all standard pipe and tubing sizes, straight, angle and three-way—½" to 1¼".

Handsize compactness permits installation where space is limited—will fit in baseboard enclosures.

All wiring is low-voltage.

Zonvalve's positive temperature control makes it ideal for modernization or for use on steam and hot water systems. Specify Zonvalve. Install Zonvalve.

Zonvalve's Trade-Mark is your guarantee of positive zone control. Accept no substitute!

ZONVALVE

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IN CANADA: HEAT TIMER CO. · 767 WARDEN AVE., SCARBOROUGH · TORONTO, ONT.

NEW PERSONNEL

Appointment of William F. Balthrop as president of CHRYSLER CORPORATION'S AIRTEMP DIVISION was announced. Mr. Balthrop succeeds P. M. Augenstein who has resigned to accept an executive position with another company. Mr. Balthrop, 41, graduated from the University of Tennessee and has a master's degree in engineering. He joined Chrysler Corporation in 1944 as a graduate student engineer and has held many positions of responsibility in the corporation. For the past year he has been president of the Amplex Division, which is also part of the corporation's Special Products Group. . . .

BELL & GOSSETT CO., Morton Grove, Ill., has announced two new appointments in its Refrigeration and Air Conditioning Department of the Hydro-Flo Division. Joe Flasch, previously sales manager of the department, has been named product manager and will be in charge of coordinating production, engineering and sales activities. Carl Rice was appointed field sales manager from his previous position as production application engineer. . . .

Appointment of William D. Widerman as vice-president in charge of sales for JOHN J. NESBITT, INC., was announced. Mr. Widerman will supervise and coordinate all company sales activities and will headquarter at the main plant, State Road & Rhawn Street in Philadelphia. . . .

C. T. Roff was elected the new President of ANEMOSTAT CORPORATION OF AMERICA by the Board of Directors. F. A. Waechter was elected vice-president-finance. Mr. Roff, formerly vice-president of production and engineering, has been with the Company since 1946.

BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

CANADIAN SUMMER DATA—Increasing interest in temperature and humidity data for Canadian cities for use in connection with air conditioning has prompted the Meteorological Branch of the Canadian Department of Transport to publish No. 5 in its series of Meteorological Memoirs. In it are percentage frequencies of dry- and wet-bulb temperatures from June to September at selected cities. The author is C. C. Boughner. Copies at 75c each are available from the Queen's Printer and Controller of Stationery, Ottawa, Ontario. Request Catalog T57-2/5.

CALCULATING HEATING-COOLING LOADS—A simplified method of heating and cooling load calculating whereby glass, shading, latitude, and other factors are combined in easy-to-read tabular form has been developed by and is available from Arkla Air Conditioning Corp., 812 Main Street, Little Rock, Ark. It consists of a 94-page *Comfort Guide* manual ($2), a companion pad of 50 load estimating forms (50c), and a pad of 25 psychrometric charts (25c). Tables cover single- and double-width window glass, glass block, walls, roofs, ceilings, floors, partitions, people, appliances, and ventilation air. In the appendix are tables on simplified air volume calculations, heat removal, building materials lag, and shade factors.

NEW ARI STANDARDS—Three new standards, consolidating and updating a number of existing standards covering refrigerant liquid receivers, water-cooled refrigerant condensers, and refrigerant-cooled liquid coolers, have been published by Air-Conditioning and Refrigeration Institute. ARI-450-61, *Water-Cooled Refrigerant Condensers*, supersedes tentative Standards 4-52 and 4-54 (1953), *Construction of Ammonia Condensers;* tentative Standard 4-62 (1953), *Freon Water-Cooled Condensers*, and pertinent parts of Standards 4-53 and 4-55 (1953), *Performance of Ammonia Condensers*, and tentative Standard 4-81 (1953), *Application of Heat Transfer Equipment.*

ARI 480-61, *Refrigerant-Cooled Liquid Coolers, Remote Type*, supersedes tentative Standards 4-71, 4-72, and 4-76 (1953), *Water and Brine Coolers*, and pertinent parts of Standard 4-81 (1953), *Application of Refrigerant Heat Transfer Equipment.*

ARI Standard 495-61, *Refrigerant Liquid Receivers*, supersedes Standard 4-56 (1953), *Ammonia Liquid Receivers*, and Standard 4-63 (1953), *Freon Liquid Receivers.*

Standards are available from ARI, 1346 Connecticut Avenue, N.W., Washington 6, D. C. Standards 450 and 480 are priced at 75c each, and 495 at 35c.

(More reviews on next page)

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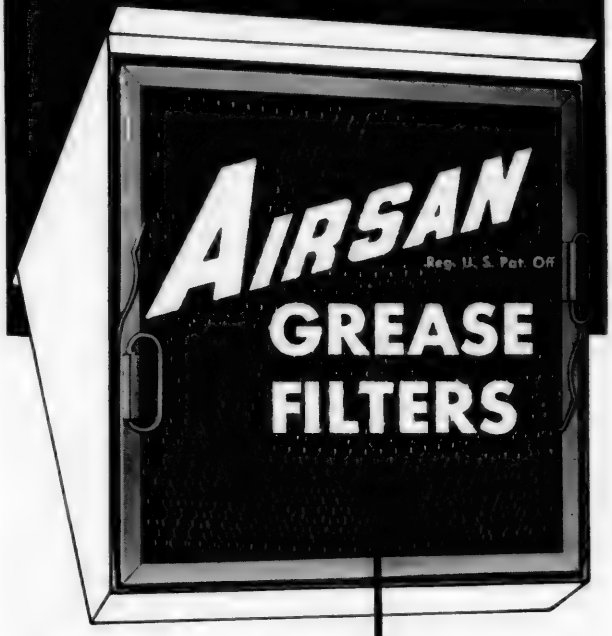
PROLONG THE LIFE OF FANS, MOTORS AND EQUIPMENT!



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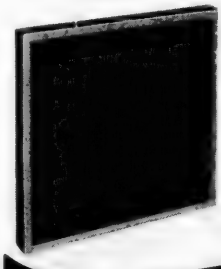

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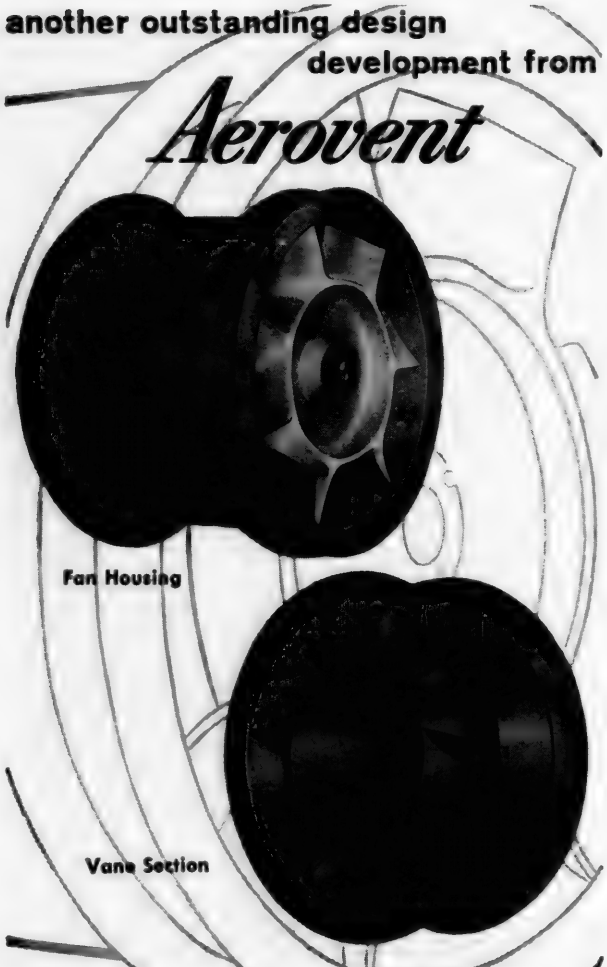

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BOOK REVIEWS

(Continued from page 127)

ESTIMATOR'S MANUAL—An accurate and convenient method of estimating labor for complete plumbing and mechanical work in any given system, plant, or location is given in *Estimator's Heating, Plumbing and Air-Conditioning Manhour Manual* by John S. Page. Scores of tables, the result of hundreds of time-and-method studies, are valuable guides to estimating manhours in every phase of plumbing and mechanical work. Available from Gulf Publishing Co., P.O. Box 2608, Houston, Tex., at $7.50, the manual gives the reader a dependable way of getting a production efficiency percentage by applying all known local conditions and variables. Subject areas covered include: service piping (including shop fabrication and field fabrication and erection); plumbing and drainage, earthwork; concrete and masonry work; air conditioning, heating and ventilating; and equipment installation.

FUEL OIL, WATER HEATER STANDARDS—Standards of the Fuel Oil and Water Heater Manufacturers Association, Inc., 50 E. 42nd Street, New York 17, N. Y., are available for $2 per copy. Included are standards on design and construction and on thermal design for "below-water-line" fuel oil heaters, for instantaneous water heaters and convertors, ethylene glycol solution convertors, and high temperature water steam generators, convertors, and heat exchangers. Appendices of pressure drop for flow inside tubes, normal fouling factors, and determining log mean temperature difference are included.

BRI PUBLICATIONS—Four additional publications of Building Research Institute, 2101 Constitution Ave., N.W., Washington 25, D. C., are available. *The Design Potential of Metal Curtain Walls*, Publication 788, is taken from the proceedings of BRI's 1959 Fall Conferences. It costs $5. Included are papers on case studies of selected buildings, creative design, new specifications, etc. Proceedings of the 1960 Spring Conferences are the subject of *Information Requirements for Selection of Plastics for Use in Building*, Publication 833 ($3), which includes papers covering roof materials, ceiling components, floors and flooring, pipe and fittings, partitions and wall coverings; *Adhesives in Building: Lamination of Structural Timber Beams, Bonding of Cementitious Materials, Bonding of Gypsum Drywall Construction*, Publication 830 ($5); and *Proposals for New Building Research*, Publication 831 ($4).

RADIANT-ACOUSTIC CEILING MANUAL—Burgess-Manning Co., Architectural Products Div., Libertyville, Ill., has published an *Engineering Manual* on radiant heating, cooling and acoustic ceiling. It covers theory, construction, installation, and characteristics. Bound in a red, loose-leaf binder, the Manual costs $25 and contains 200 pages of data, drawings, and specifications. Since all copies are registered, each will be supplemented at regular intervals with additional materials.

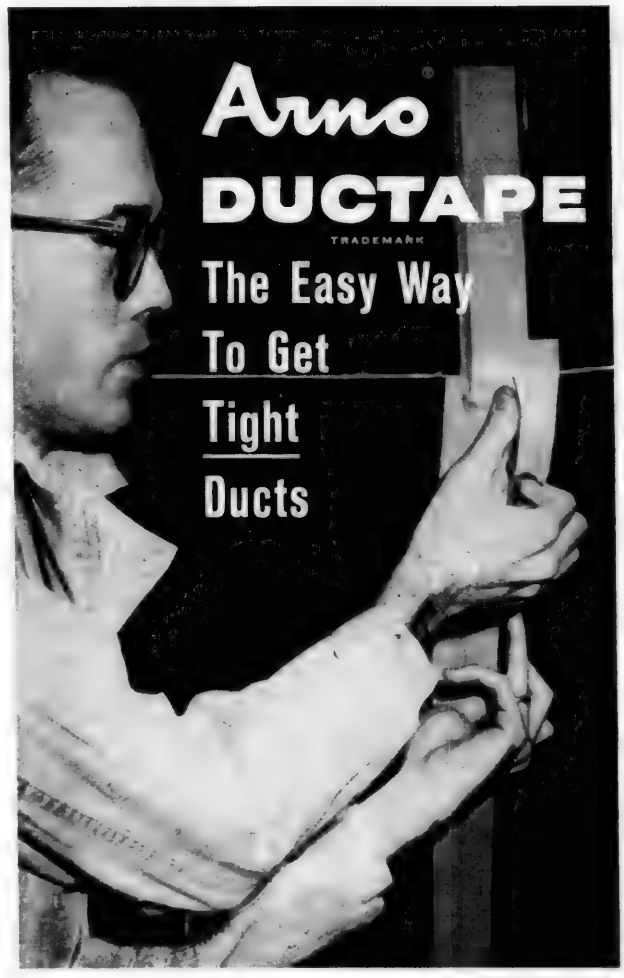
PLASTIC PIPE STANDARD—Commercial Standard CS197-60, *Flexible Polyethylene Plastic Pipe* is available, according to the Office of Technical Services, U. S. Department of Commerce. The revised Commercial Standard covers requirements for material, workmanship, dimensions, working pressure, field pressure, incremental pressure, sustained pressure and environmental cracking for three types of resin, as well as one schedule and two series of polyethylene pipe, used principally for conveying potable water. Methods of marking and indicating compliance with this Standard are included. The revision was initiated by The Society of the Plastics Industry, Inc., and has been endorsed by a representative cross-section of the industry. Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 15c.

AIR POLLUTION BIBLIOGRAPHY—A new OTS Selective Bibliography listing U. S. Government research reports, foreign translations, and other technical documents on the problems and effects of air pollution and methods and equipment for purification has been published by the Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce, Washington 25, D. C. The bibliography, which may be purchased from OTS for 10c, is SB-448, entitled *Air Pollution and Purification*, which lists 124 U. S. Government research reports and translations of foreign literature on air pollution by nonradioactive fumes, industrial gases, smokes, aerosols, and other contaminating agents. Articles from Communist China and the Soviet Union are included in the translations listing. Subject categories include problems and effects of air pollution; studies in levels of pollution; and methods and equipment for air purification.

A complete list of more than 200 OTS Selective Bibliographies may be obtained on request without charge from OTS, U. S. Department of Commerce, Washington 25, D. C.

CONTROL OF MOTORS—Parts I and II of *Magnetic Control of Industrial Motors*, by Gerhart W. Heumann, subtitled *Control Devices and Assemblies* and *A-C Motor Controllers*, treat of magnetic devices and accessories as used for control of industrial motors. These devices are used as individual motor starters or as power actuators in automatic control systems. In what is primarily an application book, controllers for industrial type motors are carefully analyzed and each type of motor is considered. Included are principal circuits, selection of sizes and components, economic factors in selection, motor protection, and codes and standards. Each part (of what will be a three-part book) is available from John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. Price for each is $9.

(More reviews on next page)



Seal every duct joint with Ductape and you'll cut your heat losses. The specially formulated adhesive sticks to metal, wood, cement, paper and plastics. Seals heat in and cold air out. Its tough fabric backing conforms to any contour to insure a snug, tight job that is done in minutes. Easy to apply — no wetting, no mixing, no mess, no waiting. Saves costly manhours!

Simplifies application of insulation to both heating and air conditioning ducts. Ideal for joints in slab ducts . . . it's waterproof. Available in four colors. *Flame-resistant* type (meets ASTM specifications) for high temperature applications. Ask your jobber for it.

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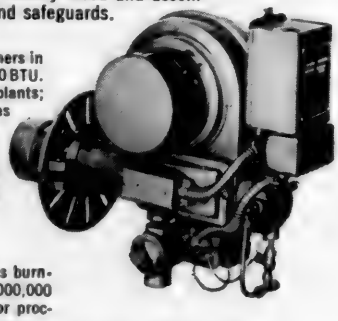

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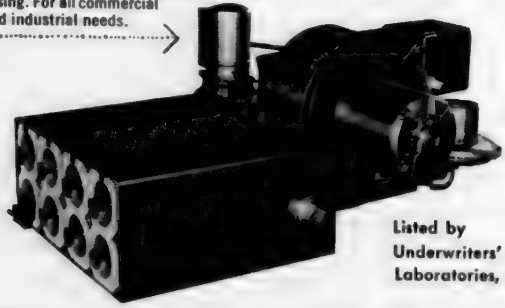

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BOOK REVIEWS

BASIC ELECTRICITY—Basic principles of direct and alternating currents is the subject of Volume 1 of *Basic Electricity*, a soft-bound, 88-page book by Clifford H. McLain, plant engineer with Uniform Tubes, Inc., Collegeville, Pa. The company is publishing the book, which is available for $2. The seven lectures comprising the book were, first, the basis for an industrial training course for students from stock clerks to those holding graduate degrees in engineering; second, revised and rewritten, a series in the *Pennsylvania Plumbing Contractor*. The manner of presentation is so direct, simple, and basic, that anyone who needs a knowledge of the subject will benefit from it. Mr. McLain is the author, also, of "Fluid Flow in Pipes," an Industrial Press publication.

HANDBOOK OF FLUID DYNAMICS is the title of an engineering and scientific level handbook—prepared by a panel of experts—broadly covering fluid flow principles, theory, methods, and allied data. Although the coverage is highly practical with specific applications to the fields of hydraulic power, propulsion, aerodynamics, petroleum production, and chemical reaction, theory is included where necessary for a clearer understanding of the underlying principles.

The book is divided into two parts—the first dealing with fundamental concepts and the second devoted to applied fields. There are discussions of basic equations of fluid flow, laminar flow, flow with chemical reaction, compressible flow, and cavitation. Among the other subjects covered are turbulence, motion of immersed and floating bodies, two-phase flow, flow measurements, sedimentation, turbomachinery and pipelines.

More than thirty well-known engineers and scientists—representing a cross-section of industry, government laboratories, and universities—have contributed to the discussions and have presented material on such advances in the field as: fluid power transmission and control; jet and rocket propulsion; stratified flow; magnetohydrodynamics; and computer calculations for fluid flow problems. In addition, many detailed illustrations are used as aids for the reader and to provide current values of important fluid dynamics data.

Victor L. Streeter, Editor-in-Chief, has been actively engaged in the field of fluid dynamics for many years. He is presently professor of hydraulics in the University of Michigan's Civil Engineering Department. The Handbook contains 1,240 pages, and is available from McGraw-Hill Book Co., Inc., 330 W. 42 St., New York 36, N. Y. Price is $24.

BRITISH YEAR BOOK—The fourteenth issue of the *Year Book of the Heating and Ventilating Industry* is available from Technitrode Journals, Ltd., 11/13, Southampton Row, London, W.C. 1, England. It contains technical articles, British standards, labor agreements, lists of members of the Association of Heating, Ventilating and Domestic Engineering Employers, manufacturers and engineers, and a buyers' guide.

Canadian Degree-Days for May 1961*

City	May 1961	May Normal	Cumulative 1961	Cumulative Normal
Calgary, Alta.	439	460	7398	8970
Charlottetown, P.E.I.	554	560	8765	8330
Crescent Valley, B. C.	374	400	7247	7610
Edmonton, Alta.	361	410	8902	9830
Fort William, Ont.	532	540	9706	10180
Grande Prairie, Alta.	459	460	9603	10390
Halifax, N. S.	546	484	7381	7246
London, Ont.	412	330	7403	7230
Medicine Hat, Alta.	305	320	7571	8450
Moncton, N. B.	459	480	8772	8500
Montreal, P. Q.	369	270	8120	8240
North Bay, Ont.	557	470	9317	9520
Ottawa, Ont.	394	330	8335	8560
Penticton, B. C.	282	260	5971	6270
Prince George, B. C.	427	480	8305	8980
Quebec, P. Q.	483	430	9278	9240
Regina, Sask.	391	420	9374	10400
Saint John, N. B.	561	510	8583	8380
Saskatoon, Sask.	372	420	9730	10610
Timmins, Ont.	667	550	10674	11060
Toronto, Ont.	357	316	6824	6898
Vancouver, B. C.	303	320	4867	5230
Victoria, B. C.	390	350	4863	4870
Windsor, Ont.	341	270	6286	6560
Winnipeg, Man.	408	411	9995	10399

* These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

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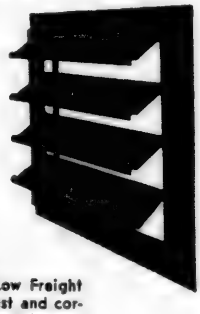

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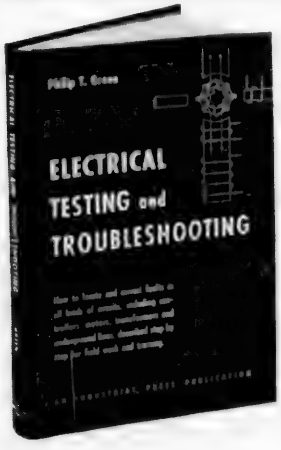

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Troubleshooting Test Equipment
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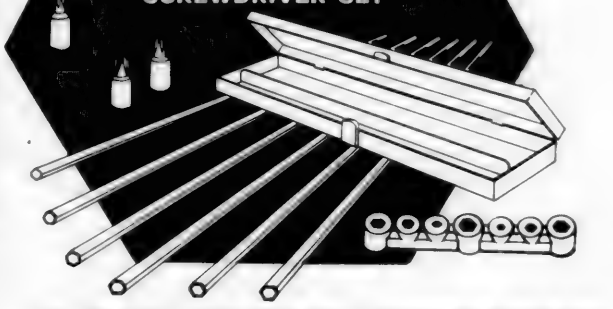

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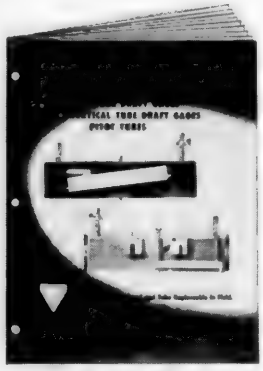

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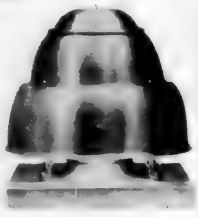

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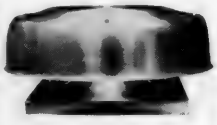
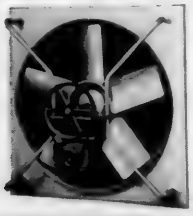
Motor and Drive are completely isolated from the air stream in this new GREENHECK LB-LINE . . . enclosed in a one piece SPUN ALUMINUM HOUSING . . . symmetrical shape lends eye appeal to any installation. Available in a size range from 16" to 48".





SIDEWALL AXIAL BELTED FAN — SAB-LINE
The design of the fan panel in the SAB line makes it possible to be used either as SUPPLY or EXHAUST by reversing the blade. Available in a size range from 24" to 48".

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

INTERNATIONAL CONFERENCE—The International Heat Transfer Conference will be held at the University of Colorado, Boulder, Colorado. Nonmembers are welcome. For information write: The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. ..... **AUGUST 28-SEPTEMBER 1, 1961.**

INDUSTRIAL BUILDING EXPOSITION—Nineteen conference sessions, covering problems of large and small companies will feature the second Industial Building and Congress, to be held at the New York Coliseum. For details write to Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y. .... **SEPTEMBER 25-28, 1961.**

WELDING FALL MEETING—The American Society fall meeting will be held in the Adolphus Hotel, Dallas, Texas. For further details write to the Information Center, American Welding Society, 33 West 39th St., New York 18, N. Y. . . **SEPTEMBER 25-28, 1961.**

INDUSTRIAL HYGIENE FOUNDATION—The 26th annual meeting of the Industrial Hygiene Foundation of America Inc. will be held at the Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13, Pa. Dr. H. H. Schrenk, Managing Director, 4400 Fifth Avenue, Pittsburgh 13, Pa. ..... **OCTOBER 25-26, 1961.**

CONSULTING ENGINEERS COUNCIL—Semi-annual meeting of CEC Board of Directors, Miami Beach, Fla. Larry N. Spiller, executive secretary, 322 Reisch Bldg., Springfield, Ill. ..... **NOVEMBER 2-4, 1961.**

R.S.E.S. INTERNATIONAL CONVENTION—The 24th annual Refrigeration Service Engineers Society International Convention will be held at the Royal York Hotel, Toronto, Ontario, Canada. Information: Convention Committee Secretary, M. F. Peddie, 51 Haven St., Toronto 19, Canada. ..... **NOVEMBER 2-5, 1961.**

NATIONAL WARM AIR—The 48th Annual Convention will be held at the La Salle Hotel, Managing Director, James M. Martin. National Warm Air Heating and Air Conditioning Association, 640 Engineers Building, Cleveland 14, Ohio. .... **NOVEMBER 6, 1961.**

BRI FALL CONFERENCES—Building Research Institute Spring Conference, Shoreham Hotel, Washington, D. C. BRI, 2101 Constitution Ave., Washington 25, D. C. .... **NOVEMBER 14-16, 1961.**

ARI EXPOSITION—Air Conditioning and Refrigeration Institute, 12th Exposition, Pan-Pacific Auditorium, Los Angeles. Information: George E. Mills, ARI Show Director, 1346 Connecticut Ave. N.W. Washington 6, D. C. ..... **FEBRUARY 12-15, 1962.**

ELECTRIC HEATING SHOW—The Second National Electric House Heating Symposium and Exposition, sponsored by Electric House Heating Section, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y., to be held at the Sherman Hotel, Chicago, Ill. Write Russell Gingles, NEMA director of public relations. ..... **MARCH 19-21, 1962.**

NACE ANNUAL CONFERENCE—18th Annual Conference and 1962 Corrosion Show of the National Assoc. of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas, to be held in Kansas City Auditorium with the Muehlebach Hotel as headquarters. T. J. Hull, Executive Secretary. Overall charge of both the conference and corrosion show L. W. Gleekman, Wyandotte Chemical Corp., Wyandotte, Michigan. ..... **MARCH 19-23, 1962.**

AMERICAN INDUSTRIAL HYGIENE CONFERENCE—Exhibits and Conference under the joint sponsorship of the American Industrial Association and the American Conference of Governmental Industrial Hygienists, will be held at the Sheraton Park Hotel, Washington, D. C. William S. Johnson, Medical Div. Bethlehem Steel Co., Bethlehem, Pa. ..... **MAY 13-17, 1962.**

CLASSIFIED ADVERTISING

Sold at $12 per column inch.

Wanted: Senior Project Engineer with broad background in domestic heating equipment to develop expanded product line for long established accessory manufacturer.

Reply to Box 983
Air Conditioning, Heating & Ventilating
93 Worth St., New York 13, N. Y.

MANUFACTURERS AGENTS

An established manufacturer with 25 years experience producing ventilating equipment is looking for manufacturer's agents in many sections of the country to sell their new line of industrial fans. The products include axial flow and tubeaxial fans, both direct and belt driven, and power roof ventilators.

Please reply Box 914, Air Conditioning, Heating & Ventilating, 93 Worth St., New York 13, N. Y.

New Government Surplus Oil Burning Boilers for 2,500 ft. steam or hot water. Ideal for large apartment house or industrial use. Fraction of original cost. Also approved A.G.A. Surplus Gas Conversion Burners.

Austin Mfg. Corp.
61 Austin St., Worcester, Mass.

WANTED

SUPERINTENDENT, MECHANICAL CONTRACTOR—Excellent opportunity for experienced piping superintendent with N.Y.C. contractor operating in the Metropolitan area. Must be versed in multi story operations and all modern techniques. Essential that he possess capabilities to handle successfully a group of foremen and a large number of pipe fitters. Reply stating qualifications and any other pertinent information to Box 984, Air Conditioning, Heating & Ventilating, 93 Worth St., New York 13, N. Y.

HELP WANTED MALE

Jr. Mech. Engineer, 3-5 years experience in professional offices in design of heating, ventilating, air conditioning and plumbing systems. B.S. Degree in Mechanical Engineering required. Permanent employment. Furnish education and work background. Advise salary desired and availability. George, Miles & Buhr—Architects and Engineers, Box 1068, Salisbury, Maryland.

BOOKS

. . . give you the answers to your job problems. And it's easy to get them by mail. Just read the descriptions on the insert opposite the back cover and use the prepaid order card to get the ones you want.

when the heat's on

R-900 Multi-Temp
900,000 BTU/hr. Input

be sure it's

When the job's got to be right . . . at the right price . . . remember Hydrotherm!

Gas heat costs less than oil heat in big jobs (to 3,600,000 BTU/Hr) when you install Hydrotherm's MULTI TEMP hydronic system.

Sequence-fired combustion chambers permit automatic input modulation in accordance with load requirements — no short cycling — no override — built-in standby protection. Factory assembled . . . fits through a 2 ft. 6 in. door.

Easy to install, all cast iron, and guaranteed for 10 years . . . you can't miss with Hydrotherm.

Write for bulletin #HY-F107 and all the facts.

HYDROTHERM MULTI TEMP

HYDROTHERM, INC. • DEPT. 13AC, NORTHVALE, N. J.

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Use this Digest to locate and refer to the advertisements in which you are particularly interested; then fill out and mail a prepaid postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

VALVES that stand hard work longer were specified for Gates Rubber plant. 2500 Jenkins valves are controlling processing and service lines.
Inside Front Cover — Item 200

STEAM TRAP CAPACITY is discussed in this month's ad, and in 48-page steam trap book, by Armstrong Machine Works.
Page 1 — Item 201

ROOF-MOUNTED year-round prefabricated air conditioning system, called Atmos-Pak, is offered in 10 models by Air Conditioning, Inc. Information is available.
Page 2 — Item 202

FLUSH VALVES from Coyne & Delany are being applied in the 170-room El Ponce Intercontinental, Puerto Rico. Catalog 66 is offered.
Page 5 — Item 203

LOW VELOCITY acoustic terminal control units from Carnes Corp. are described in ATC Catalog No. 1361.
Page 7 — Item 204

HIGH VELOCITY acoustic terminal control units from Carnes Corp. are described in ATC Catalog No. 1160.
Page 9 — Item 205

MODULAR DIFFUSER for versatile air distribution is described by Carnes Corp. in Catalog No. 460.
Page 11 — Item 206

LIQUID PHASE HEATER provides 600-degree temperatures without any pressure. Vapor Heating Corp. offers Bulletin 4023.
Page 13 — Item 207

CONTROL SYSTEM provided by Johnson Service Co. regulates temperatures and humidities and keynotes plant efficiency for textile machinery plant.
Pages 14-15 — Item 208

FIN TUBE RADIATION from Warren Webster & Co. Inc. has new design and construction features inside and out. Faster, easier installation is just one advantage. Information is available.
Pages 16-17 — Item 209

CENTRALIZED CONTROL PANELS made by Minneapolis-Honeywell provide a custom job from standard units. Full details are offered.
Pages 18-19 — Item 210

INDIRECT WATER HEATER from Bryan Steam Corp. can serve multiple temperature water heating requirements. Complete specifications are offered in Form 630.
Page 20 — Item 211

AIR VOLUME is easy to control on a Buensod dual-duct air mixing unit. Knurled nut adjusts, smaller nut locks. System fits new structures or renovations with equal ease.
Page 21 — Item 212

COST-SAVING PRODUCTS manufactured by Halstead & Mitchell include cooling towers, condensers, finned coils and air handlers. Ad describes specific bulletins which are available.
Page 22 — Item 213

FIBER GLASS PIPE INSULATION is quickly installed, provides top thermal insulation at Fontainbleau Towers addition in Miami Beach. Pittsburgh Plate Glass Co. offers information.
Page 23 — Item 214

CENTRIFUGAL PUMPS called Series 1510-B by Bell & Gossett Co. offer more than pumps of comparable capacities. Selection data are available.
Page 25 — Item 215

RETURN AIR VENT SILENCERS stop noise transmission without blocking air flow. Koppers Co., Inc. announces additional information.
Page 26 — Item 216

NEW COIL from McQuay Inc. provides high performance efficiency for water, steam, direct expansion or special fluids. Information is available.
Page 27 — Item 217

PROPORTIONAL CONTROLS for positioning air dampers, control valves, etc., are introduced by Penn Controls, Inc. Additional information is available.
Pages 28-29 — Item 218

FLUSH VALVES made by Sloan Valve Co. are called performance proven and time tested. Information is available.
Page 30 — Item 219

UNIT HEATERS from Bryant Mfg. Co. offer three advantages and are AGA approved for all gases. Immediate delivery is promised.
Page 31 — Item 220

HEATING SPECIALTIES including valves, traps, vents, gages and thermometers are offered by Marsh Instrument Co. and described in heating specialties catalog.
Page 32 — Item 221

CAST IRON SECTIONAL BOILERS for all fuels are manufactured by Weil-McLain Co. A condensed catalog of commercial and industrial boilers is offered.
Page 33 — Item 222

NEW AIR DIFFUSERS from Barber-Colman Co. provide independent control of air volume and pattern to insure comfort. Information is contained in Control-Line Bulletin F-10431.
Pages 34-35 — Item 223

THERMOSTATIC SHOWER MIXING VALVE is made by Lawler Automatic Controls to be completely recessed into the wall.
Page 36 — Item 224

AN ALL AMBIENT air-cooled condensing unit is announced by Tuck-Aire Furnace Co. Complete specifications are available.
Page 37 — Item 225

MAKE-UP AIR is the subject of this month's ad by the Westinghouse Sturtevant Div. who also offers a make-up air booklet.
Page 39 — Item 226

EXTRUDED ALUMINUM GRILLES and registers are available in a new, complete line from Tuttle & Bailey. Additional information is offered.
Pages 40-41 — Item 227

THE REFRIGERANTS you want, packaged the way you want them, are provided by General Chemical Div., of Allied Chemical.
Page 42 — Item 228

Ad-Digest

COPPER TUBE made by Anaconda American Brass Co. has excellent corrosion resistance and heat transfer properties. Publication B-1 is offered.
Page 43 Item 229

COMPLETELY SELF-CONTAINED air conditioning units are being manufactured by Governair Corp. in single units up to 120-ton capacity. Information is available.
Page 44 Item 230

PREFABRICATED GLASS FIBER DUCT from Gustin-Bacon Mfg. Co. is called ideal for commercial duct systems. Information is available.
Page 45 Item 231

GAS AIR CONDITIONING with Arkla water chiller provides low cost heating and cooling for Battenfeld Grease and Oil Corp. Information is available.
Page 47 Item 232

"BACTERIA TIGHT" BLOWERS from Peerless Electric assure constant ventilation at National Animal Disease Laboratories. Line information is available.
Page 48 Item 233

REFRIGERATION SPECIALTIES from Sporlan Valve Co. provide peak performance for air conditioning. Information is available.
Page 49 Item 234

AUTOMATIC AIR VENTS for hydronic heating and cooling systems are described in a catalog which is offered by manufacturer, Maid-O-Mist, Inc.
Page 111 Item 235

FACTORY COOLING using direct-fired heaters as basic units is proposed by Lennox in this month's ad. Factory production will increase up to 28%. Additional information is offered.
Pages 112-113 Item 236

PUBLIC SPACE AIR HANDLERS from Drayer-Hanson were installed in the Hotel Quito, "Jewel of the Andes". Company offers brochure CSHV 312.01.
Page 114 Item 237

BALANCING AIR FLOW SYSTEMS with the Alnor Velometer allows you to be sure the first time. Meter is sensitive, readings are quick and accurate.
Page 115 Item 238

FLEXIBLE HOSE and retractable duct with metal duct systems lower installation costs. The Flexaust Co. offers details.
Page 116 Item 239

VENTILATORS from The Burt Mfg. Co. will meet any ventilating problem that roof ventilators can solve. Complete line—data book is offered.
Page 117 Item 240

TEMPERATURE INDICATING INSTRUMENTS, actuated by mercury, are offered by Palmer Thermometers, Inc. Catalog is available.
Page 118 Item 241

DUCT FAN made by DeBothezat Fans Div. has removable cone design which cuts maintenance cost. Information is available.
Page 119 Item 242

CHEMICAL MAINTENANCE PRODUCTS and consulting services are offered by Metropolitan Refining Co. Complete information is available.
Page 120 Item 243

POWER DRAFT UNITS from Quickdraft Corp. provide higher combustion efficiency and lower maintenance costs. Engineering data are available.
Page 121 Item 244

SLIDE RULE developed by Titus Mfg. Corp. is a combination outlet selector and air flow calculator. Furnished complete with 24-page instruction manual, slide rule costs $2.50. Use ad coupon to order.
Page 121

POSITIVE SEALING INDICATORS, called Liquid Eye by Allin Mfg. Co., are described in catalog E-57.
Page 121 Item 245

SEWAGE PUMP for heavy duty use is offered by Kenco Pump Div. Unit is completely submersible, of rugged cast-bronze construction, and provides for leg supports.
Page 122 Item 246

GROUP FACILITIES for washing and showering are available from Bradley Washfountain Co. Information is contained in Publication No. 6004.
Page 123 Item 247

WATER SOFTENER from Elgin Softener Corp. provides the answer for commercial jobs where dependability is a must. Bulletin is available.
Page 124 Item 248

DUAL FUEL BURNER is adaptable to and superior in any configuration. Webster Engineering offers literature.
Page 125 Item 249

PACKLESS ZONING VALVE is offered by Heat-Timer Corp. and provides complete shutoff with no seepage. Brochure D-7 is available.
Page 126 Item 250

GREASE FILTERS reduce fire hazards and prolong the life of fans, motors, and equipment. Air Filter Corp. announces free bulletin.
Page 127 Item 251

DIRECT-CONNECTED VANEAXIAL FANS with removable vane sections are made by Aerovent Fan Co. Inc. and described in Bulletin 475.
Page 128 Item 252

TIGHT DUCTS are easy to obtain with Ductape, made by Arno Adhesive Tapes, Inc. Information and a 15-foot test sample are available.
Page 129 Item 253

GAS BURNERS from Power Flame Div. come in models to fit every residential, commercial and industrial application. Information is offered.
Page 130 Item 254

EXTRUDED ALUMINUM SHUTTERS are made by Elgo Shutter & Mfg. Co. Complete specifications are available.
Page 131 Item 255

SOLENOID VALVES with epoxy-clad coils (at no extra cost) are new, waterproof, and available from Jackes Evans Mfg. Co. Information is offered.
Page 131 Item 256

MAGNETIC HEX WRENCH and Phillips type screwdriver set are available from Watsco, Inc. Information is offered.
Page 131 Item 257

DRAFT GAGE CATALOG describes complete line of draft gages and pitot tubes available from Ellison Draft Gage Co. Designated Bulletin 109-E.
Page 132 Item 258

AIR MOVERS made by Greenheck Fan & Ventilator Corp. are illustrated and described in ad. Catalog containing complete details is available.
Page 132 Item 259

HYDRONIC SYSTEM called Multi Temp by Hydrotherm, Inc., is economical and efficient. Bulletin HY-F107 contains all the facts.
Page 133 Item 260

REFRIGERATION PRODUCTS from Henry Valve Co. include valves, filter-driers and moisture-liquid indicators. Information is available.
Inside Back Cover Item 261

CONTROL APPLICATIONS for McDonnell products in a typical commercial building are illustrated in four-color, three-foot wide chart, available from McDonnell & Miller, Inc.
Back Cover Item 262

Advertisements in this issue are summarized on the Ad-Digest pages preceding this page. If you want more information on advertised products, locate the Digest item number of that advertisement, circle the item number on either of the post-cards provided below.

Use the post-cards below

to obtain catalogs mentioned in this issue or further information on products described or advertised in this issue.

1. Circle item numbers of new equipment and catalog descriptions
2. Circle item numbers of advertisements as shown in the Ad-Digest on the preceding pages
3. Mail . . . we'll do the rest

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STREET .....

CITY .....ZONE ....STATE .....

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July '61

FIRST CLASS
Permit No. 53
New York, N. Y.

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Air Conditioning, Heating and Ventilating
93 WORTH STREET
NEW YORK 13, N. Y.

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July '61

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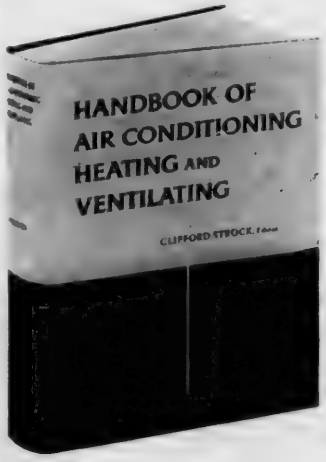
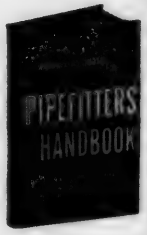


HANDBOOK OF AIR CONDITIONING, HEATING AND VENTILATING

Edited by Clifford Strock

Completely new book containing thousands of facts, figures, data and principles; hundreds of charts, tables and maps. Answers problems you face every day in your work. Subjects treated thoroughly include: Air Conditioning, Air Handling, Building Heat Loss, Climatic Data, Combustion, Degree-Days, Dual Duct Design, Dust Collection, Fuel Estimating, High Velocity Air, Mathematics, Motors, Piping and Plumbing, Psychrometry, Radiator Heating, Refrigerants, Service Hot Water, Solar Data, Steam Flow, Ventilation, Warm Air Heating, Terminology and a Complete cross index. **1094 Pages, 7¾" x 10¾", 598 Charts, Maps, Illus., 518 Tables, $15.00.**



PIPEFITTERS HANDBOOK

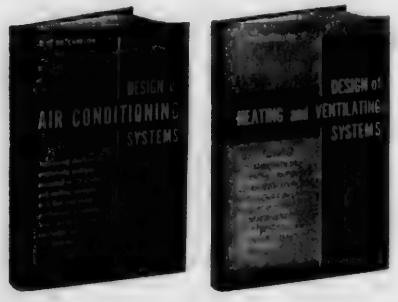
Enlarged Second Edition
by Forrest R. Lindsey

Written by a pipefitter for pipefitters. Covers: Pipe Bending — Screwed Offsets — Mitered Joints — Dimensions—Screwed Fittings — Butt Welding Fittings — Flanges and Flanged Fittings—Solder Joint Fittings—U-Bolts—Spacing of Hangers—Water in Pipes—Pipe Expansion—Identification—Contents of Tanks — Valves — Plastic Pipe — Metals — Steam — Mathematical Data — Measures — Conversion Tables—Trigonometry—Field Layout of Angles — Dictionary. **416 Pages, 248 Illustrations, $6.00.**

DESIGN OF AIR CONDITIONING SYSTEMS

by F. W. Hutchinson

115 full-page charts solve problems of air conditioning system design involving cooling load, duct design, psychrometrics, solar energy, comfort conditioning, panel cooling, etc. For each chart the engineering and mathematical background plus design example and solution are given. **336 Pages, 118 Illus., $7.00.**



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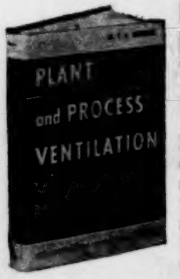

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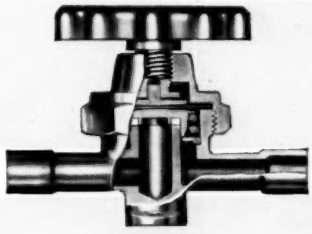

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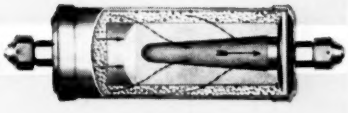

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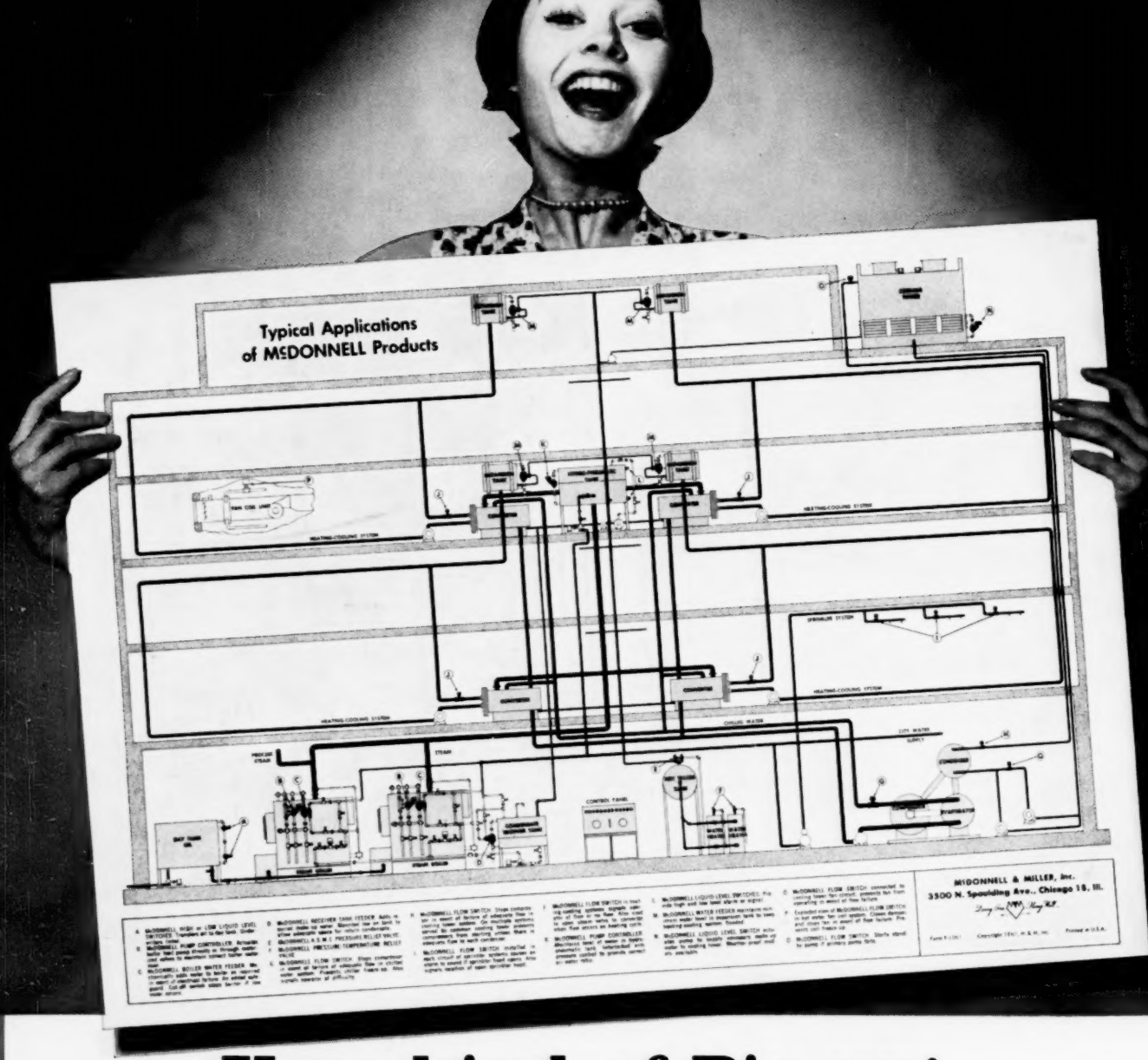

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